HEWLETT PACKARD

SERVICE MANUAL

7911, 7912 AND 7914 DISC/TAPE DRIVES

Manual part no. 07912-90903
Microfiche part no. 07912-90803

Printed: JUL 1985 07912-90903
Printed in U.S.A. E0785

MODELS COVERED

This manual covers the HP 7911R, HP 7911P, HP 7912R, HP 7912P, HP 7914R, and HP 7914P Disc/Tape Drives.

OPTIONS COVERED

This manual covers options 001, 015, and 140 as well as the standard disc/tape drives.

DESIGNED FOR HP-IB SYSTEMS

HP-IB: Not just IEEE-488, but the hardware, documentation and support that delivers the shortest path to a computation system.

FOR U.S.A. ONLY

The Federal Communications Commission (in 47 CFR 15.818) has specified that the following notice be brought to the attention of the users of this product.

FEDERAL COMMUNICATIONS COMMISSION
RADIO FREQUENCY INTERFERENCE STATEMENTS

Warning: This equipment generates, uses, and can radiate radio frequency energy and if not installed and used in accordance with the instructions manual, may cause interference to radio communications. It has been tested and found to comply with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference when operated in a commercial environment. Operation of this equipment in a residential area is likely to cause interference in which case the user at his own expense will be required to take whatever measures may be required to correct the interference.

The above statement applies only to stand-alone cabinet model disc/tape drives. The rackmount model disc/tape drives are sold as component products and are incomplete in nature. These products have not been tested to comply with the limits for Class A computing devices pursuant to Subpart J of Part 15 of FCC Rules which are designed to provide reasonable protection against such interference when operated in a commercial environment. When installed in a complete computing device product, these units require testing to the Class A limits.

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PRINTING HISTORY

New editions incorporate all update material since the previous edition. Updating Supplements, which are issued between editions, contain additional and revised information to be incorporated into the manual by the user. The date on the title page changes only when a new edition is published.

First Edition ..... APR 1982
Second Edition ..... AUG 1982
Third Edition ..... DEC 1982
Fourth Edition ..... JAN 1984
Fifth Edition ..... AUG 1984
Sixth Edition ..... JUL 1985

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SAFETY CONSIDERATIONS

KEEP WITH MANUAL

GENERAL - This product and related documentation must be reviewed for familiarization with safety markings and instructions before operation.

SAFETY SYMBOLS

Instruction manual symbol: the product will be marked with this symbol when it is necessary for the user to refer to the instruction manual in order to protect the product against damage.

Indicates hazardous voltages.

Indicates earth (ground) terminal.

WARNING The WARNING sign denotes a hazard. It calls attention to a procedure, practice, or the like, which, if not correctly performed or adhered to, could result in injury. Do not proceed beyond a WARNING sign until the indicated conditions are fully understood and met.

CAUTION The CAUTION sign denotes a hazard. It calls attention to an operating procedure, practice, or the like, which, if not correctly performed or adhered to, could result in damage to or destruction of part or all of the product. Do not proceed beyond a CAUTION sign until the indicated conditions are fully understood and met.

SAFETY EARTH GROUND - This is a safety class I product and is provided with a protective earthing terminal. An uninterruptible safety earth ground must be provided from the main power source to the product input wiring terminals, power cord, or supplied power cord set. Whenever it is likely that the protection has been impaired, the product must be made inoperative and be secured against any unintended operation.

BEFORE APPLYING POWER - Verify that the product is configured to match the available main power source per the input power configuration instructions provided in this manual.

If this product is to be energized via an autotransformer (for voltage reduction) make sure the common terminal is connected to the earth terminal of the main power source.

SERVICING

WARNING

Any servicing, adjustment, maintenance, or repair of this product must be performed only by service-trained personnel.

Adjustments described in this manual may be performed with power supplied to the product while protective covers are removed. Energy available at many points may, if contacted, result in personal injury.

Capacitors inside this product may still be charged even when disconnected from its power source.

To avoid a fire hazard, only fuses with the required current rating and of the specified type (normal blow, time delay, etc.) are to be used for replacement.

To install or remove a fuse, first disconnect the power cord from the device. Then, using a small screwdriver, turn the fuseholder cap counterclockwise until the cap releases. Install the proper fuse in the cap — either end of the fuse can be installed in the cap. Next, install the fuse and fuseholder cap in the fuseholder by pressing the cap inwards and then turning it clockwise until it locks in place.

GENERAL INFORMATION

SECTION I

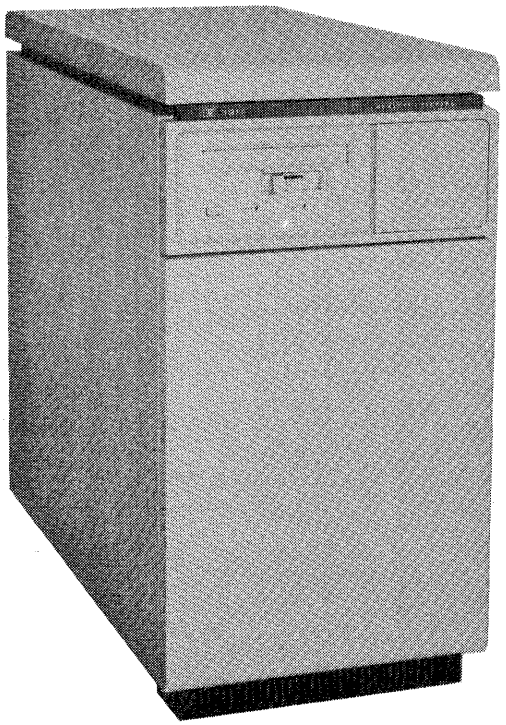
1-1. INTRODUCTION

The Hewlett-Packard 7911, 7912, and 7914 Disc/Tape Drives (see figure 1-1), hereafter referred to as drives, are medium performance, random access, data storage devices which utilize "Winchester" technology. The sealed drive assemblies use one (HP 7911) or two (HP 7912 and HP 7914) 356-millimetre (14-inch) diameter lubricated, oxide-coated discs. Two heads are used for each disc surface. Half the surface of one disc is dedicated to servo code which provides position information.

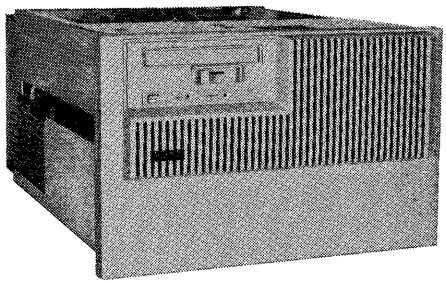
The formatted storage capacities of the HP 7911, HP 7912, and HP 7914 are 28.1 megabytes, 65.6 megabytes, and 132.1 megabytes, respectively. Each drive includes a built-in Hewlett-Packard Interface Bus (HP-IB) controller, a power supply, and a built-in 67 megabyte cartridge tape back-up device. The "R" packaging configuration provides for cabinet rack mounting. The "P" configuration is mounted in a stand-alone cabinet.

The disc drive consists of a rigid cast disc module assembly. This disc module includes an electromagnetic rotary head positioning system, spindle, spindle and blower motor, air filtration and cooling system, and all the associated electronic components. A card cage in the disc module houses a number of printed circuit assemblies (PCA's). Slots in the card cage are available for the optional dedicated tape drive controller PCA's. All of the PCA's are easily accessible at the bottom front of the rackmounted models and at the bottom left front on stand-alone cabinet models.

The data preamplifiers, write drivers and head select circuits are loaded on a flexible circuit attached to the actuator inside the sealed portion of the disc drive. A detachable power supply module mounted at the rear of the disc module contains a power transformer, filter capacitors, ac input circuitry, and the power regulator PCA. In this manual "drives" refers to all models, unless otherwise specified.



STAND-ALONE DRIVE



RACKMOUNT DRIVE

Figure 1-1. HP 7911, HP 7912, and HP 7914 Disc/Tape Drives

Each drive (except option 140) includes a cartridge tape unit. This unit uses a DC 600 type preformatted data cartridge that provides either 16.7 megabytes (150-foot) or 67 megabytes (600-foot) of storage. Tapes are ordered in groups of five per box; both certified and uncertified tapes are available. Before uncertified tapes can be used in host-initiated data transactions, they must be certified by the host computer. To upgrade an option 140 disc drive to a standard disc/tape drive, refer to the *Cartridge Tape Drive Upgrade Manual,* part no. 5957-6471.

1-2. SCOPE OF MANUAL

This manual is organized as follows:

- Section I — contains a general description of the drives.
- Section II — provides information about the CS/80 Instruction Set and Hewlett-Packard Interface Bus (HP-IB).
- Section III — presents both functional and detailed block operation.
- Section IV — contains service information including diagnostic information and block diagrams of each functional system.
- Section V — lists step-by-step removal and replacement procedures for all field-replaceable parts.
- Section VI — contains parts lists and figures for all field-replaceable parts as well as ordering information.

1-3. LOGIC SIGNAL NOTATION

In the drive logic circuits, a digital signal is applied at its destination at all times in one of two states: active or inactive. The signal is active when the voltage level (high or low) makes the action occur for which the signal was designed. This action is usually the same as that identified by the signal mnemonic. A signal mnemonic with an "L" suffix indicates an active low signal. A signal mnemonic with an "H" suffix indicates an active high signal. Table 1-1 lists the active and inactive states of two such signals (FSS-L and SEK-H) to illustrate the logic notation.

Signal mnemonics without an "L" or "H" suffix are generally analog or clock signals. Typical examples are SP1 (Servo Preamp Line 1) and SCK (Servo Clock).

1-4. DOCUMENTATION AVAILABLE

The following manuals provide additional information for the drives:

- *HP 7911, HP 7912, and HP 7914 Disc/Tape Drive Operator Instructions,* part number 07912-90901.
- *HP 7911, HP 7912, and HP 7914 Disc/Tape Drive Operating and Installation Manual,* part number 07912-90902.
- *CS/80 Instruction Set Programming Manual,* part number 5955-3442.
- *Site Environmental Requirements for Disc/Tape Drives,* part number 5955-3456.
- *CS/80 External Exerciser Reference Manual,* part number 5955-3462.

1-5. OPTIONS AVAILABLE

The options available with the drives are as follows:

- Option 001 — adds a dedicated tape drive controller.
- Option 015 — provides 220 volt, 50 Hz power strapping.
- Option 140 — deletes the cartridge tape drive.

Table 1-1. Logic Signal Notation

SIGNAL MNEMONIC	VOLTAGE LEVEL	SIGNAL CONDITION	MESSAGE TRANSMITTED
FSS-L	low	active	Formatter/Separator selected
FSS-L	high	inactive	Formatter/Separator not selected
SEK-H	high	active	Drive in seek mode
SEK-H	low	inactive	Drive not in seek mode

CHANNEL INTERFACE

SECTION II

2-1. INTRODUCTION

Interface to the drives is accomplished through Hewlett-Packard Interface Bus (HP-IB) hardware and the CS/80 Instruction Set, a set of commands formulated for mass storage devices. The following paragraphs discuss the types of CS/80 commands. Also provided is an overview of HP-IB. For full details of CS/80, refer to the *CS/80 Instruction Set Programming Manual,* part no. 5955-3442.

2-2. CS/80 INSTRUCTION SET

The increase in capabilities of both host computers and mass storage devices has emphasized the need for efficient channel communication. The CS/80 Instruction Set increases the efficiency and speed of channel operations between disc memories and their associated host computers. Table 2-1 is a summary of all CS/80 instructions. The CS/80 Instruction Set allows a host computer to access special utilities within the drives. Utilities are routines stored in firmware which allow error rate tests to be performed and the results of such tests to be examined or logged. Utilities are listed in table 2-2.

2-3. TRANSACTION STRUCTURE

A transaction is a logically complete operation between a system host computer and a peripheral device (drive) over a given channel (HP-IB). Three phases may occur during each transaction: command, execute, and report. A transaction begins when a command is received by the drive, and ends when a reporting message indicating the status of the transaction is accepted by the host. Figure 2-1 illustrates the transaction structure, and shows the relationship between the drive operating states and the channel activity relative to each phase.

A unit is a separately addressable entity within a device (drive). The drive contains three units: the controller unit, a disc unit, and a tape unit. A volume is a separately addressable portion of the storage media within a given unit. Each unit in the drive has one volume: the disc unit contains fixed disc media; the tape unit utilizes removable tape media. The controller unit is addressed during diagnostic routines.

2-4. REAL TIME COMMANDS

Real time commands are optimized for execution time. These commands are used most often in host/device transactions. One or more complementary commands may precede a real time command in order to modify the operation of that command. Real time commands include locate and read, locate and write, cold load read, and write file mark.

2-5. COMPLEMENTARY COMMANDS

Complementary commands are used to set or update programmable states in the drive. The programmable states define characteristics such as: set unit, set volume, set address, set block displacement, set return addressing mode, set length, set burst mode, set retry time, set options, set release, set status mask, and set Rotational Position Sensing (RPS) window size. These commands may be included within Real Time, General Purpose, or Diagnostic command messages, or they may stand alone.

When a complementary command (or commands) is embedded within another command, the parameters or conditions established by that complementary command(s) are altered only for the duration of the current command. A stand-alone complementary command, however, sets the parameters or conditions until the same stand-alone complementary command alters the set value or until power-on occurs. Power-on resets all complementary commands to their default values. Therefore, at power-on, length is defaulted to equal the entire volume. A stand-alone Set Length command may give it a "set" value of 1 kbyte to be used for an entire sequence of transactions, although some special case commands could temporarily override this value with an embedded complementary command to set a "current" value of 256 bytes (for 1 sector).

2-6. GENERAL PURPOSE COMMANDS

This command group includes commands which allow the host to determine device type and operating characteristics or to ascertain storage media integrity. These commands are not considered "real time" commands and therefore should not be issued by the host unless it is willing to relinquish control of the drive for a varying period of time. General purpose commands are: locate and verify, copy data, spare block, release, release denied, describe, initialize media, and unload.

2-7. DIAGNOSTIC COMMANDS

Diagnostic commands are intended to assist the host in isolating problems in the device to the replaceable assembly level. Some commands allow protected access to variables or data maintained by the device

Table 2-1. CS/80 Command Summary

COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
LOCATE AND READ (REAL TIME)	[00000000]	00	000	NULL	0	NO VARIABLES OR PARAMETERS	LOCATES DATA INDICATED BY TARGET ADDRESS AND TRANSMITS DATA TO HOST.
LOCATE AND WRITE (REAL TIME)	[00000010]	02	002	STX	2	NO VARIABLES OR PARAMETERS	TRANSFERS DATA FROM HOST TO STORAGE AREA BEGINNING AT ADDRESS SPECIFIED BY TARGET ADDRESS.
LOCATE AND VERIFY (GENERAL PURPOSE)	[00000100]	04	004	EOT	4	NO VARIABLES OR PARAMETERS	INSTRUCTS DEVICE TO PERFORM AN INTERNAL VERIFICATION OF A SECTION OF DATA TO ENSURE THAT IT CAN BE READ.
SPARE BLOCK (GENERAL PURPOSE)	[00000110]	06	006	ACK	6	[00000110] [00000S0T] S = 0 SKIP SPARE S = 1 JUMP SPARE T = 0 RETAIN DATA T = 1 DO NOT RETAIN DATA T MUST EQUAL 1 FOR TAPE OPERATION S MUST EQUAL 0 FOR DISC OPERATION	ALLOWS HOST TO GIVE DEVICE PERMISSION TO BECOME TEMPORARILY BUSY WHILE SPARING BLOCK INDICATED BY TARGET ADDRESS.
COPY DATA (GENERAL PURPOSE)	[00001000]	08	010	BS	8	[00001000] [0VVV0UUU] [0001000T] [P1] - - - - - - - - [P6] SET ADDRESS / 6-BYTE PARAMETER ADDRESS OF DATA SOURCE [0XXX0WWW] [0001000T] [P1] - - - - - - - - [P6] SET ADDRESS / 6-BYTE PARAMETER ADDRESS OF DATA DESTINATION VVV = VOLUME NUMBER ON UUU FROM WHICH DATA IS COPIED UUU = UNIT NUMBER OF DATA SOURCE T = ADDRESS MODE (0 = SINGLE VECTOR, 1 = 3-VECTOR) XXX = VOLUME NUMBER ON WWW TO WHICH IS COPIED WWW = UNIT NUMBER OF DATA DESTINATION T = ADDRESS MODE (0 = SINGLE VECTOR, 1 = 3-VECTOR)	COPIES AMOUNT OF DATA SPECIFIED BY LENGTH (DEFAULT VALUE, OR COMPLEMENTARY COMMAND VALUE) FROM THE SPECIFIED UNIT AND VOLUME TO A SELECTED UNIT AND VOLUME. FOR THE TAPE, AN UNWRITTEN BLOCK OR BAD KEY CAUSES THE COPY DATA TO TERMINATE.
COLD LOAD READ (REAL TIME)	[00001010]	0A	012	LF	10	NO VARIABLES OR PARAMETERS	USED BY HOST SYSTEM TO BOOTSTRAP ITSELF INTO A HIGHER OPERATING ENVIRONMENT FROM A MORE PRIMITIVE STATE.
REQUEST STATUS (DIAGNOSTIC)	[00001101]	0D	015	CR	13	NO VARIABLES OR PARAMETERS	INSTRUCTS DEVICE TO RETURN (IN AN EXECUTION MESSAGE) THE STATUS OF THE LAST TRANSACTION.

Table 2-1. CS/80 Command Summary (continued)

COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
RELEASE (GENERAL PURPOSE)	[00001110]	0E	016	SO	14	NO VARIABLES OR PARAMETERS	USED TO RELEASE DEVICE FOR A PERIOD OF TIME.
RELEASE DENIED (GENERAL PURPOSE)	[00001111]	0F	017	SI	15	NO VARIABLES OR PARAMETERS	PROHIBITS DEVICE FROM RELEASING ITSELF.
SET ADDRESS (COMPLEMENTARY)	[00010000] [00010001]	10 11	020 021	DLE DC1	16 17	[0001000T] [P1] - - - - - - - - [P6] 6-BYTE PARAMETER T = ADDRESS MODE: 0 = SINGLE VECTOR, 1 = 3-VECTOR SINGLE VECTOR FORMAT: 6-BYTE BINARY NUMBER 3-VECTOR FORMAT: P1 - P3 = CYLINDER ADDRESS P4 = HEAD ADDRESS P5 - P6 = SECTOR ADDRESS	USED TO SET VALUE OF TARGET ADDRESS, SPECIFIES SINGLE-OR THREE-VECTOR ADDRESS MODE. UPON COMPLETION OF AN INSTRUCTION WHICH UTILIZES A TARGET ADDRESS, THE TARGET ADDRESS IS AUTOMATICALLY INCREMENTED.
SET BLOCK DISPLACEMENT (COMPLEMENTARY)	[00010010]	12	022	DC2	18	[00010010] [P1] - - - - - - - - [P6] 6-BYTE PARAMETER PARAMETER FORMAT: 6-BYTE, SIGNED, TWO'S COMPLEMENT, BINARY NUMBER	ADJUSTS TARGET ADDRESS BY NUMBER OF BLOCKS INDICATED BY PARAMETER FIELD. ESPECIALLY USEFUL IN TAPE OPERATIONS.
SET LENGTH (COMPLEMENTARY)	[00011000]	18	030	CAN	24	[00011000] [P1] - - - - - - - - [P4] 4-BYTE PARAMETER PARAMETER FORMAT: 4-BYTE, UNSIGNED BINARY NUMBER	DEFINES THE NUMBER OF BYTES IN A DATA TRANSFER.
SET UNIT (COMPLEMENTARY)	[00100000] [00100001] [00101111]	20 21 2F	040 041 057	space ! /	32 33 47	[0010YYYY] (0000 = DISC; 0001 = TAPE) YYYY = UNIT NUMBER (1111 = DEVICE CONTROLLER) UNIT NUMBER MUST BE FIRST BYTE IN A COMMAND	USED TO SPECIFY A SPECIFIC UNIT NUMBER WITHIN A MASS STORAGE DEVICE.
INITIATE UTILITY (DIAGNOSTIC)	[00110000] [00110001] [00110010]	30 31 32	060 061 062	0 1 2	48 49 50	[001100XX] [P1] [P2] - - - - - - - - [P9] UP TO 8-BYTE PARAMETER XX = EXECUTION MESSAGE QUALIFIER 00 = NO EXECUTION MESSAGE 01 = DEVICE WILL RECEIVE EXECUTION MESSAGE TEXT 10 = DEVICE WILL SEND EXECUTION MESSAGE TEXT P1 = UTILITY NUMBER (SEE TABLE 2-2) PARAMETER QUANTITY AND CONTENT IS FUNCTION OF P1.	DIRECTS DEVICE TO PERFORM ONE UTILITY ROUTINE. SEE SECTION IV.

Table 2-1. CS/80 Command Summary (continued)

COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
INITIATE DIAGNOSTIC (DIAGNOSTIC)	[00110011]	33	063	3	51	[00110011] [P1] - - - - - - - - [P3] 3-BYTE PARAMETER	DIRECTS DEVICE TO PERFORM ONE INTERNALLY DEFINED DIAGNOSTIC ROUTINE. SEE SECTION IV.
NO OP (COMPLEMENTARY)	[00110100]	34	064	4	52	NO VARIABLES OR PARAMETERS	CAUSES DEVICE TO DISREGARD MESSAGE BYTE.
DESCRIBE (GENERAL PURPOSE)	[00110101]	35	065	5	53	NO VARIABLES OR PARAMETERS	DEVICE RETURNS 256 BYTES OF INFORMATION WHICH GIVES ALL DEVICE CHARACTERISTICS (SEE CS/80 INSTRUCTION SET MANUAL).
INITIALIZE MEDIA (GENERAL PURPOSE)	[00110111]	37	067	7	55	[00110111] [00000CWZ] [P2] CWZ FOR TAPE UNIT: Z = 0: REWRITE SPARING TABLE WITH NO JUMP SPARES. Z = 1: RESET SPARING TABLE TO INITIAL SPARES. W = 0: INITIAL SPARES ARE EVERY 512TH BLOCK WITH TRACK OFFSET. W = 1: INITIAL SPARES ARE NO SPARES. C = 0: RUNS CERTIFICATION UTILITY ON TAPE. C = 1: INHIBITS CERTIFY TEST. MEDIA REMAINS UNINITIALIZED. CWZ FOR DISC UNIT: 000 = RETAIN BOTH FACTORY (PRIMARY) AND FIELD (SECONDARY) SPARES. 001 = RETAIN FACTORY SPARES ONLY. 010 = INITIALIZE MAINTENANCE TRACKS ONLY. 011 = RETAIN NO SPARES (CE USE ONLY). P2 = BLOCK INTERLEAVE BYTE (BINARY NUMBER). MUST BE 00 FOR TAPE.	USED TO INITIALIZE ALL OF THE DATA FIELDS OF THE UNDEFINED MEDIA AREA (CURRENT UNIT NUMBER AND VOLUME). FACTORY SPARES SHOULD ALWAYS BE RETAINED. CAN ALSO BE USED TO INITIALIZE MAINTENANCE TRACKS.
SET OPTIONS (COMPLEMENTARY)	[00111000]	38	070	8	56	[00111000] [00000VYZ] V = 0 DISABLE AUTO SPARING (POWER-ON VALUE) V = 1 ENABLE AUTO SPARING Y = 0 JUMP SPARE (POWER-ON VALUE) Y = 1 SKIP SPARE Z = 0 DISABLE CHARACTER COUNT (POWER-ON VALUE) Z = 1 ENABLE CHARACTER COUNT	USED TO SPECIFY SPARING TECHNIQUE AND CHARACTER COUNT CAPABILITY FOR THE TAPE MODULE.
SET RPS (COMPLEMENTARY)	[00111001]	39	071	9	57	[00111001] [TIME 1] [TIME 2] TIME 1 = TIME-TO-TARGET IN HUNDREDS OF MICROSECONDS TIME 2 = WINDOW SIZE IN HUNDREDS OF MICROSECONDS IF TIME 1 = 0, RPS IS DISABLED	SETS TIME-TO-TARGET AND WINDOW-SIZE TIME INTERVALS FOR RPS DATA TRANSFERS. (RPS = ROTATIONAL POSITION SENSING)

Table 2-1. CS/80 Command Summary (continued)

COMMAND	OPCODE FORMAT					COMMAND FORMAT	FUNCTION
	BINARY	HEX	OCTAL	ASCII	DECIMAL		
SET RETRY TIME (COMPLEMENTARY)	[00111010]	3A	072	:	58	[00111010] [P1] [P2] P1 - P2 = RETRY TIME IN TENS OF MILLISECONDS (16 BIT BINARY NUMBER) POWER-ON VALUE = 100 MILLISECONDS	USED TO SET AMOUNT OF TIME AVAILABLE FOR READ AND SEEK RETRIES.
SET RELEASE (COMPLEMENTARY)	[00111011]	3B	073	;	59	[00111011] [TZ000000] T = 1: SUPPRESS RELEASE TIME-OUT Z = 1: RELEASE AUTOMATICALLY DURING IDLE TIME	USED TO SUPPRESS RELEASE TIME-OUT AND TO ENABLE AUTOMATIC RELEASE.
SET BURST (COMPLEMENTARY)	[00111100] [00111101]	3C 3D	074 075	< =	60 61	[0011110T] [P1] T = 0 INDICATES THAT LAST BURST ONLY IS TAGGED WITH A MESSAGE TERMINATOR (EOI ON HP-IB). T = 1 INDICATES THAT ALL BURSTS ARE TAGGED WITH A MESSAGE TERMINATOR. P1 = NUMBER OF 256 BYTE SEGMENTS IN EACH BURST (IF P1 = ALL ZEROS, BURST MODE IS DEACTIVATED).	ACTIVATES (AND DEACTIVATES) BURST MODE.
SET STATUS MASK (COMPLEMENTARY)	[00111110]	3E	076	>	62	[00111110] [P1] - - - - - - - - [P8] 8-BYTE PARAMETER PARAMETER FORMAT: BIT POSITIONS IN PARAMETER BYTES CORRESPOND TO STATUS REPORT ERROR BIT POSITIONS. REFER TO CS/80 INSTRUCTION SET MANUAL. 1 = MASKED ERROR	ALLOWS MASKING OF ERROR CONDITIONS REPORTED BY REQUEST STATUS (DIAGNOSTIC) COMMAND.
SET RETURN ADDRESSING MODE (COMPLEMENTARY)	[01001000]	48	110	H	72	[01001000] [00000TTT] TTT = ADDRESSING MODE 000 = SINGLE VECTOR 001 = 3-VECTOR	USED BY HOST TO SPECIFY TYPE OF ADDRESS (SINGLE OR 3-VECTOR) TO BE RETURNED IN REQUEST STATUS EXECUTION MESSAGE.
WRITE FILE MARK (REAL TIME)	[01001001]	49	111	I	73	NO VARIABLES OR PARAMETERS	WRITES A FILE MARK AT THE CURRENT POSITION OF THE TAPE.
UNLOAD (GENERAL PURPOSE)	[01001010]	4A	112	J	74	NO VARIABLES OR PARAMETERS	UNLOADS THE TAPE.

Table 2-2. Drive Utilities

UTILITY OPCODE(S) ALLOWED* (HEX)	MICRO OPCODE (HEX)	UTILITY PERFORMED BY THE DISC/TAPE DRIVE
32	C0	Read Full Sector
32	C1	Read Error Summary
32	C3	Read Revision Numbers
32	C4	Read Drive Tables
32	C5	Read Run Time Data Error Log
32	C6	Read Error Rate Test Data Error Log
32	C7	Read Fault Log (Disc) or Use Log (Tape)
30, 32	C8	Initiate Pattern Error Rate Test
30, 32	C9	Initiate Read Only Error Rate Test
30, 32	CA	Initiate Short Error Rate Test
30, 32	CB	Initiate Random Error Rate Test
30, 32	CC	Initiate Random Read Only Error Rate Test
30	CD	Clear Logs
30	CE	Preset Drive
31	D1	Receive User Pattern

*Opcode 30 Executes Utility With No Message
Opcode 31 Executes Utility Receive Message
Opcode 32 Executes Utility Send Message

(such as error information), while others cause tests to be performed within the drive, or on a specific area of the storage media. Diagnostic commands may be modified by complementary commands. Initialize diagnostic, initialize utility, and request status are all diagnostic commands.

2-8. TRANSPARENT MESSAGES

Transparent commands compensate for different types of channels and differences in operating environments. Transparent commands are intercepted by the drive firmware and modify the normal command-execution-reporting transaction sequence. Transparent commands are explained in the *CS/80 Instruction Set Programming Manual,* part no. 5955-3442.

2-9. HEWLETT-PACKARD INTERFACE BUS

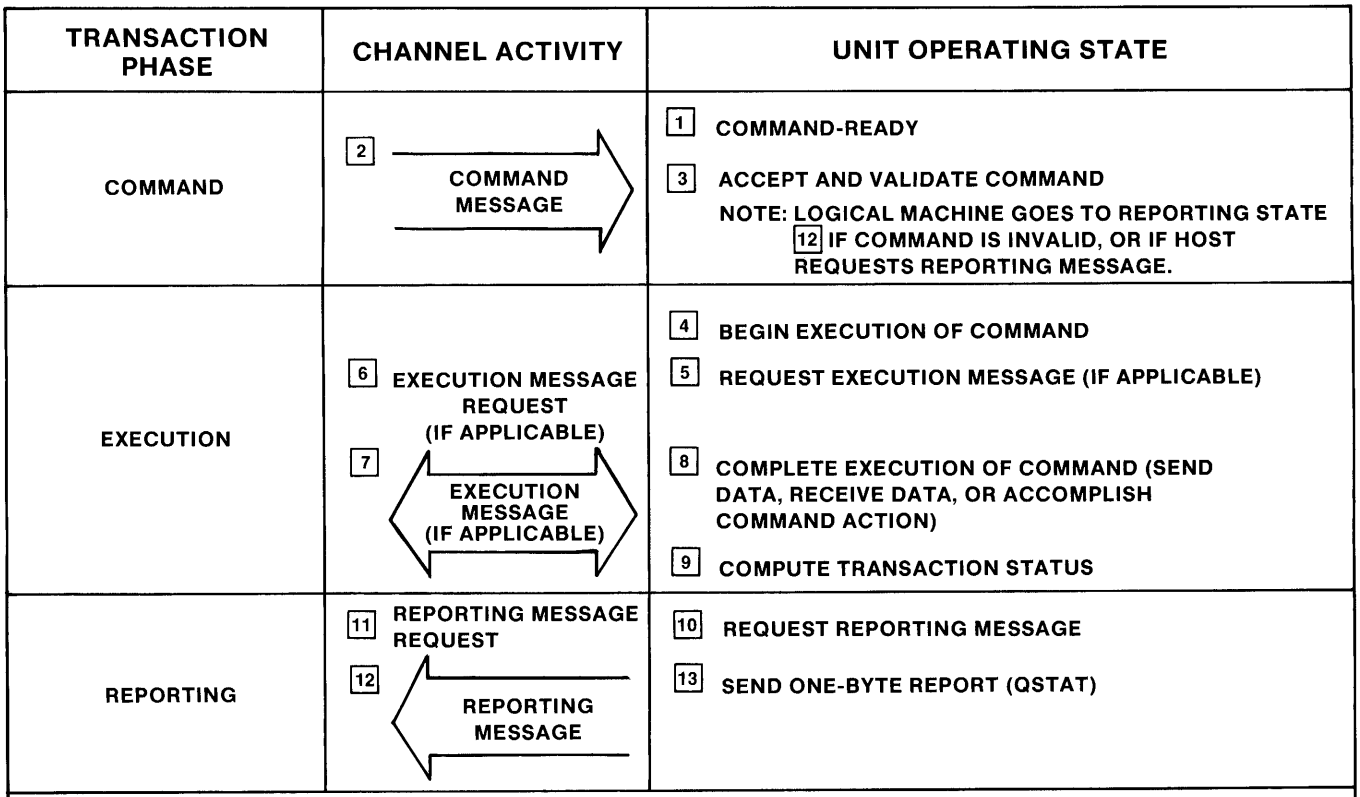
The Hewlett-Packard Interface Bus (HP-IB) provides a standardized method of connecting separate devices (see figure 2-2). The HP-IB permits transfer of commands and data between the components of a system on 16 signal lines. The interface functions for each system component are performed within the component so only passive cabling is needed to connect the system. The cable connects all controllers and other devices of the system in parallel.

The Hewlett-Packard Interface Bus (HP-IB) has certain rules which must be followed for successful installation of the drives. Cabling is limited to 1 metre per HP-IB load. Typically the Central Processing Unit (CPU) is 7 equivalent loads and the drive is 1 equivalent load.

The CPU adheres to an HP standard which allows 7 metres of HP-IB cable between the CPU and the nearest device connected to it and 1 metre of cable between each additional device. The maximum configuration is eight devices (not including CPU) per HP-IB channel or a maximum of 15 metres or 15 equivalent loads.

The eight Data I/O lines are reserved for the transfer of commands, data, and other messages in a byte-serial, bit-parallel manner. Data and message transfers are asynchronous, coordinated by three handshake lines: Data Valid (DAV-L), Not Ready For Data (NRFD-L), and Not Data Accepted (NDAC-L). The other five lines are for bus management.

Information is transmitted on the data lines under sequential control of the three handshake lines (DAV-L, NRFD-L and NDAC-L). No step in the sequence can be initiated until the previous step has been completed. Information transfer can proceed as fast as devices can respond, but no faster than allowed by the slowest device presently addressed. This permits several devices to receive the same message byte concurrently.



1 Logical Machine idle in command-ready state.

2 Host sends command message.

3 Logical Machine accepts and verifies command. If command is valid, Logical Machine moves to execution state. If not, Logical Machine moves to reporting state.

4 Unit begins execution of command.

5 6 If command involves data transfer, Logical Machine requests an execution message. If not, unit completes execution.

7 Execution message is established if command involves a data transfer.

8 Unit completes execution of command. If command involves data transfer, unit sends or receives data through channel module. If not, unit completes action called for in command message.

9 Logical Machine computes completion status of transaction. Pass/Fail status is set into QSTAT, complete status set into request status.

10 11 Logical Machine requests reporting message.

12 Reporting message is established.

13 Logical Machine sends one-byte reporting message (QSTAT) indicating Pass/Fail status of transaction. Host must send request status command for complete status report (20 bytes).

Figure 2-1. Transaction Structure

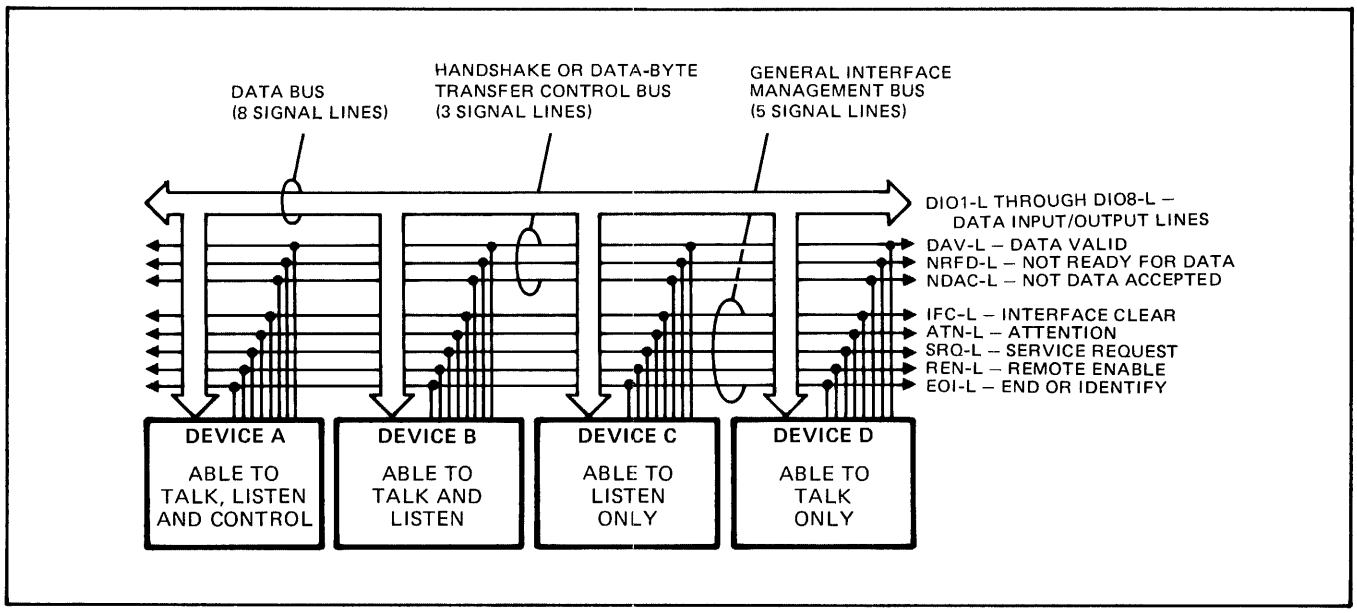


Figure 2-2. Hewlett-Packard Interface Bus Signal Lines

Devices connected to the bus may be talkers, listeners, or controllers (refer to table 2-3). The Controller-In-Charge (CIC) dictates the role of each of the other devices by setting the Attention (ATN-L) line low and sending talk or listen addresses on the data lines. Addresses are set for each device at the time of system configuration. While the ATN-L line is low, all devices must listen to the data lines. When the ATN-L line is high, devices that have been addressed will send or receive data; all others ignore the data lines. Several listeners can be active simultaneously but only one talker can be active at a time. Whenever a talk address is put on the data lines (while ATN-L is low), all other talkers will be automatically unaddressed.

The Interface Clear (IFC-L) line places the interface system in a known quiescent state. The Remote Enable (REN-L) line is used to select between two alternate sources of device programming data such as the front panel or the HP-IB. The End Or Identify (EOI-L) line is used to indicate the end of a multiple-byte transfer sequence. In addition, when a controller-in-charge sets both the ATN-L and EOI-L lines low, each device capable of a parallel poll responds on the DIO line assigned to it.

2-10. HP-IB COMMUNICATIONS

This section describes the formats and sequences for the HP-IB commands, messages, and transactions that occur between the Controller-In-Charge (CIC) and the drive. The following list explains the terms used in this section.

Table 2-3. HP-IB Definitions

HP-IB TERM	DEFINITION	CONSIDERATIONS
TALKER	Any device which sends information over the HP-IB.	There can be only one TALKER sending information over the HP-IB at a time.
LISTENER	Any device which receives information over the HP-IB. Some devices can function as LISTENERS or TALKERS.	In a parallel poll system, there can be up to 8 LISTENERS receiving information over the HP-IB at the same time.
CONTROLLER	Any device that has been programmed to manage data flow between the TALKER and the LISTENER(s) in addition to being a TALKER and a LISTENER.	The CONTROLLER manages data flow by addressing one device as a TALKER and one or more devices as LISTENERS. There can be only one active CONTROLLER on the HP-IB at any time. The active CONTROLLER is called the CONTROLLER-IN-CHARGE (CIC).
SYSTEM CONTROLLER	Any device that functions as a CONTROLLER and is able to gain absolute control of the HP-IB with the Interface Clear (IFC) signal.	There can be only one SYSTEM CONTROLLER connected to the HP-IB.

COMMAND — A parcel of information transmitted over the channel (HP-IB) relating to a specific operation. Channel commands (usually a single byte) are used to manage operations on the interface channel. Device commands (usually more than one byte) are used to control the operation and are contained within the text of a command message.

UNIVERSAL COMMAND — A channel command that causes all devices on the bus to perform a predetermined interface function. Refer to table 2-4.

Table 2-4. Universal Command Formats

UNIVERSAL COMMAND	UNIVERSAL DEVICE CLEAR
ATN ⟨P001CCCC⟩ P = Parity Bit CCCC = Command Code	ATN ⟨P0010100⟩ P = Parity Bit

PRIMARY COMMAND — The primary I command is a channel command that begins the message sequence. It contains the command to listen or talk and the address of a particular device. The primary II command terminates the message with an unlisten or untalk command.

SECONDARY COMMAND — The secondary command sets up the action required of the drive in the text of the message.

TEXT — The text of the message can be 1 to n bytes depending on the required action. The required action can be to receive further qualifying information or instructions (such as a device command), to receive write data, to send read or status data, or to perform a specific operation such as a CLEAR.

MESSAGE — A unique sequence of command and text bytes transmitted over the channel during which the communication link between the devices (for example, CIC and the drive) remains unbroken.

COMMAND MESSAGE — A single message containing all the information required to address a device and initiate an operation, set up a programmable parameter, or set up an operation to be executed by an execution message.

EXECUTION MESSAGE — A single message containing all the information required to carry out an operation previously set up by a command message.

TRANSACTION — A complete process or operation carried out over the channel. Some transactions are completed with only a command/report message, and some require a command, execution, and a reporting message.

2-11. CHANNEL MANAGEMENT

The following techniques are used by the CIC to manage the HP-IB: Parallel Poll and Universal Device Clear.

2-12. PARALLEL POLL. The CIC conducts a parallel poll on the HP-IB by asserting ATN-L and EOI-L simultaneously. Each device requiring service can then respond by asserting the DIO line corresponding to its address. The CIC then addresses only the device requiring service. If more than one device requires service, the CIC addresses the device with the highest priority (lowest address) first. Parallel Poll Enable (PPE) and Parallel Poll Disable (PPD) are internal states of the drive controller. PPE occurs when the drive requires service from the CIC. PPD is the opposite state and occurs whenever the drive is active (for example, busy executing a command) or idle. A Parallel Poll Response (PPR) from the drive will occur if the CIC asserts both ATN-L and EOI-L and if the drive is in the PPE state.

2-13. UNIVERSAL DEVICE CLEAR. A universal command is a channel command that causes all devices on the HP-IB to perform a predetermined interface function. Universal Device Clear erases information stored in the drive controller and places the drive in a known reset state. The universal device clear format is shown in table 2-4.

2-14. MESSAGE STRUCTURE

Each message contains the following components (refer to table 2-5).

— Primary I Command
(unidirectional from CIC to device)

— Secondary Command
(unidirectional from CIC to device)

— Primary II Command
(unidirectional from CIC to device)

— Text (bidirectional)

The CIC asserts ATN-L during primary and secondary commands to distinguish them from text information. The drive decodes the information contained in both the primary I and secondary commands to prepare for action specified in the text.

Table 2-5. HP-IB Message Structure

HEADER		TEXT	TRAILER
PRIMARY I	**SECONDARY**	**DEVICE COMMAND OR DATA**	**PRIMARY II**
(ATN) **⟨ONE BYTE⟩** — UNIDIRECTIONAL • CIC TO DEVICE — BEGINS MESSAGE • ADDRESSES DEVICE TO LISTEN OR TALK • UNIVERSAL	**(ATN)** **⟨ONE BYTE⟩** — UNIDIRECTIONAL • CIC TO DEVICE — SET UP DEVICE FOR FURTHER ACTION	**⟨ONE TO n BYTES⟩** — BIDIRECTIONAL — QUALIFYING INSTRUCTIONS TO DEVICE — WRITE DATA TO DEVICE — READ DATA TO CIC — STATUS DATA TO CIC	**(ATN)** **⟨ONE BYTE⟩** — UNIDIRECTIONAL • CIC TO DEVICE — TERMINATES MESSAGE — UNADDRESSES DEVICE • UNLISTEN • UNTALK

FUNCTIONAL OPERATION

SECTION III

3-1. INTRODUCTION

This section of the manual contains a functional level and a detailed block level theory of operation for the drives. Included are a description of the addressing structure and mode, and the sector format.

3-2. ADDRESSING STRUCTURE

The sealed disc mechanism contains two discs (see figure 3-1). In the HP 7911, only one of the discs can be used or addressed; the second disc and its associated heads are "dummies" which are used to match the mass on the spindle and rotary actuator.

The surface of each disc is divided into two concentric bands: an inner band and an outer band. A separate head is used to access each band. The outer band on the disc surface farthest from the drive belt contains servo code. These preformatted tracks, which are accessed by a read-only servo head, contain head position, sector, and timing information. The remaining bands (3 on the HP 7911; 7 on the HP 7912 and HP 7914) comprise the available data surface. The HP 7911 and HP 7912 have 572 usable data tracks per band; the HP 7914, which uses a double-density-type head, has 1,152 usable tracks per band. All inner bands have even numbered heads (0 through 2, or 0 through 6); all outer data bands have odd numbered heads (1, or 1 through 5). A band is selected when its associated head is addressed.

Two "landing zones" are available on each disc surface where the heads set down when the discs are either stopped or slowed below the operating speed. One landing zone is located inside the inner band of the disc; the other landing zone is located between the inner and outer bands. No information is recorded in these areas.

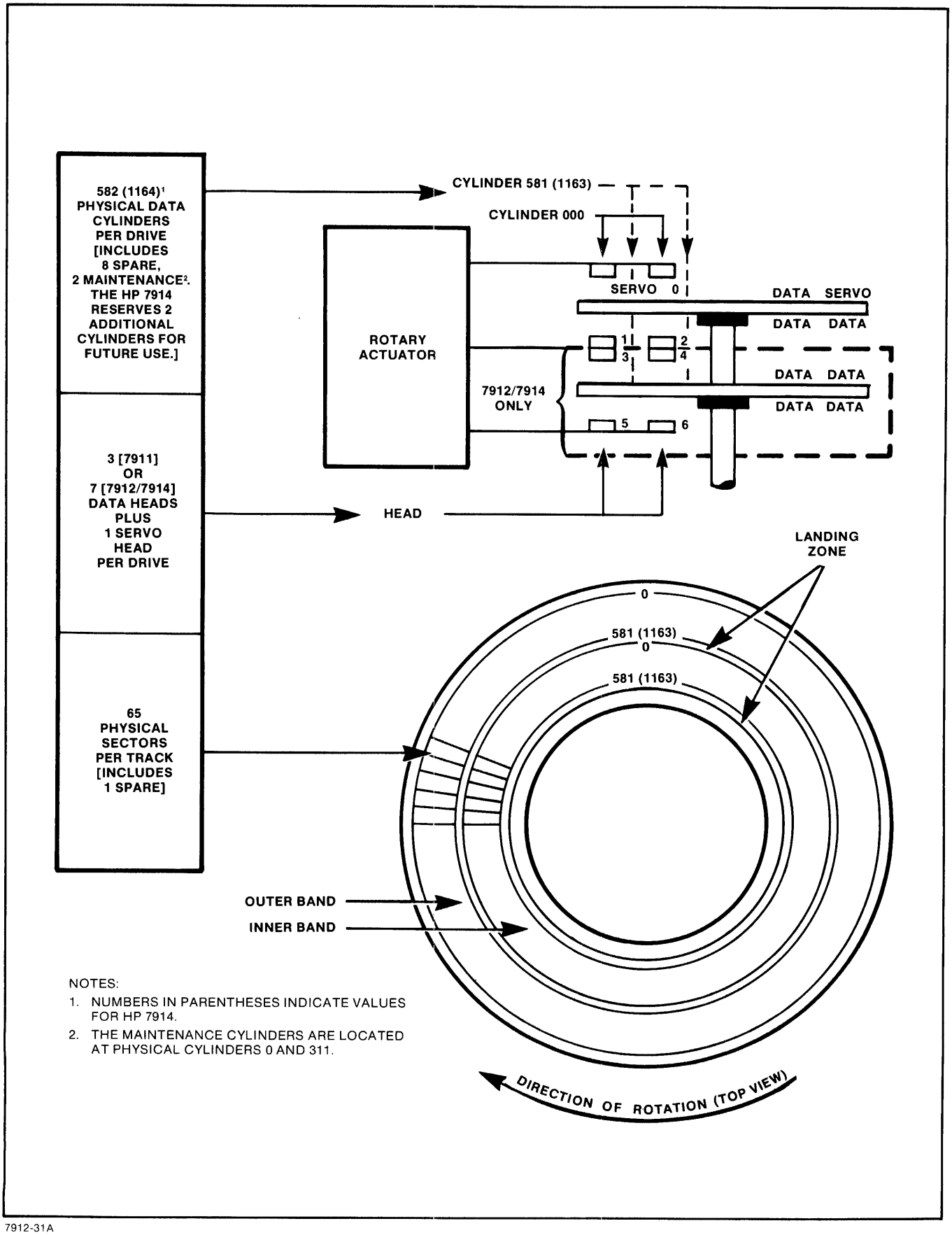
The data tracks in each band on all disc surfaces with the same track number comprise a cylinder. That is, all tracks numbered 000 (excluding the servo tracks) comprise cylinder address 000. The HP 7911 and HP 7912 usable cylinder addresses range from 000 to 571; usable cylinder addresses on the HP 7914 range from 000 to 1151. Tracks are addressed when both cylinder and head addresses are specified.

In addition to the user accessible tracks, 10 tracks exist in each band for drive maintenance (two tracks) and track sparing (eight tracks) which are not part of the user's normal address space. (The HP 7914 has two additional tracks per band reserved for future use.) Maintenance tracks are used to store track sparing tables for the microprocessor RAM; to log the location of uncorrectable data errors (and some errors to be retried), drive faults, and an overall error figure; and to store sectors written with predefined data patterns for use during read diagnostics. Maintenance tracks can be accessed by service-trained personnel using system diagnostics. One of these tracks is located at the outer edge of each band (physical track 0) and the other near the center of each band (physical track 311). Spare tracks are those addressed by the drive to write data intended for a defective track.

Each data track is divided into 64 sectors. Sectors are addressed when both head and sector addresses are specified for a given cylinder. The physical location of each data sector is determined by counting each occurrence of a sector timing pulse, which is derived from a unique pattern of servo code written on the servo surface (see figure 3-2). These sector timing pulses, which mark the beginning of each sector, occur every 256 microseconds. A second timing pulse, the index pulse, occurs only at the beginning of physical sector 0 (within 163 microseconds of every 65th sector timing pulse) and is used to reset the sector-counting electronics for the next disc revolution.

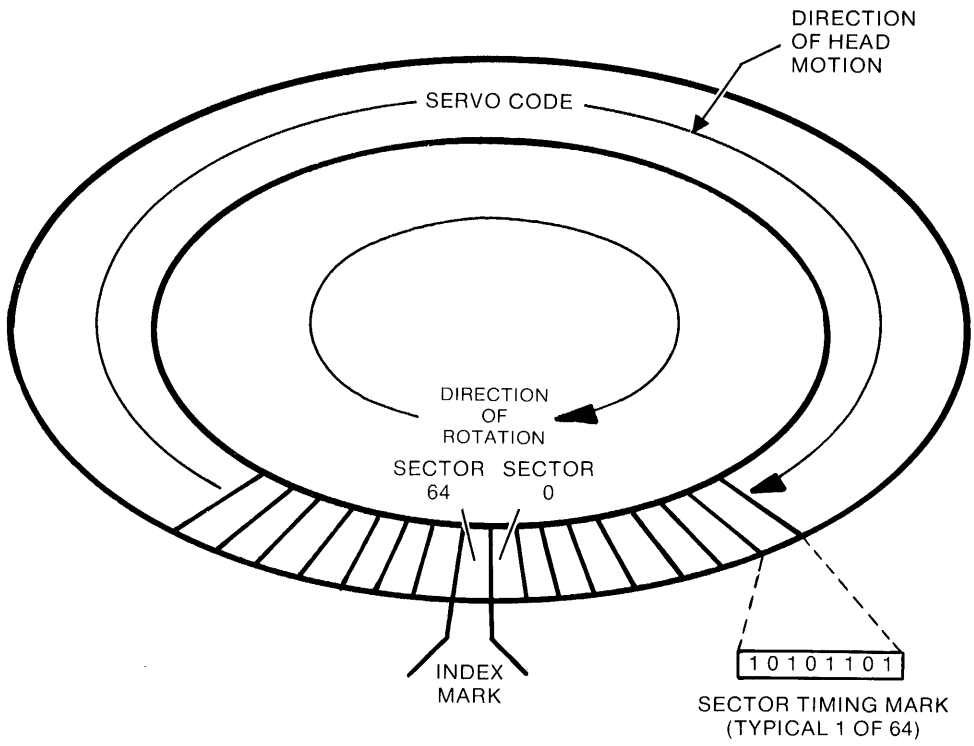
The drive keeps track of physical sectors as they pass beneath the heads. The controller, however, addresses logical sectors in order to minimize system intervention during automatic head and/or track switching.

Logical sectors are staggered as the heads increment through a cylinder, and as cylinders are incremented. Staggered sectors allow an access to the next logical track and continuation of a data transfer without waiting for a full revolution of the disc. Sector stagger between adjacent heads in the same cylinder is 10 sectors; sector stagger between the last head of one cylinder (head 2 or head 6) and the first head of the next cylinder (head 0) is 34 sectors on the HP 7911 and HP 7912, and 30 sectors on the HP 7914.



7912-31A

Figure 3-1. Addressing Structure



NOTES:
1. SECTOR TIMING MARK OCCURS EVERY 256 MICROSECONDS.
2. ONE INDEX MARK IS GENERATED PER REVOLUTION.
3. INDEX MARK OCCURS WITHIN 163 MICROSECONDS OF EVERY 65TH SECTOR TIMING MARK.

Figure 3-2. Sector Timing and Index Mark Generation

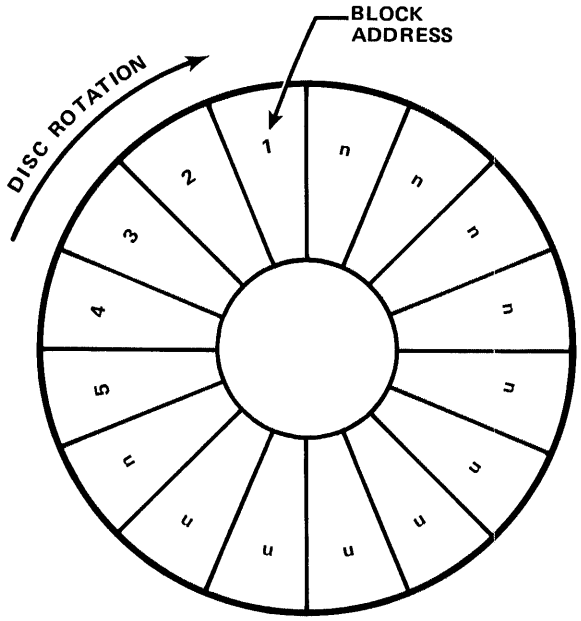
Sector interleaving is also used to save latency time (the time required to locate the first bit of the next logical sector). Sector interleaving allows the transfer rate of the drive to be matched with that of the host computer connected to it. A host computer cannot always process sectors (blocks) of data as fast as they are presented by the drive. Often, by the time the host computer is ready for another block, the drive has already passed that particular sector on the disc, and a time delay or latency equal to as much as one revolution of the disc is incurred. Sector interleaving allows the data to be staggered or interleaved by one or more sectors (see figure 3-3); access time is delayed only enough to equal that of the host computer. Sector interleaving, therefore, reduces inherent latencies which are characteristic of all rotational memories. The host specifies the interleave with the Initialize Media command. (Refer to Section II, General Purpose Commands, paragraph 2-6.)

3-3. ADDRESSING MODE

The controller operates in cylinder mode to access the data storage areas of the disc mechanism. In the cylinder mode of operation, the heads are positioned over a particular cylinder and then data is written or read starting with the lowest numbered head and continuing to the highest numbered head. A cylinder of information therefore consists of all sectors on all tracks at a given cylinder address. Head switching occurs after the data in sector 63 of the current track has been transferred. Head switching is sequential, that is, head 1 will be selected after head 0, and so forth. Data transfers will continue with sector 0 of the next track after the address fields and track status indicators of sector 63 of that track have been verified by the controller. An end-of-cylinder will occur after the data in sector 63 of the last track has been transferred. Cylinder switching (a seek operation) may take place at this time and the process repeated.

3-4. SECTOR FORMAT

The smallest directly addressable storage area on a data surface is a data sector (or block). (See figure 3-4.) Accessing a data sector is accomplished when the internal microprocessor-based controller specifies the address of the cylinder, head, and sector. Each data sector contains a 24.5-byte preamble, a 256-byte data field, and a 6.375-byte postamble.

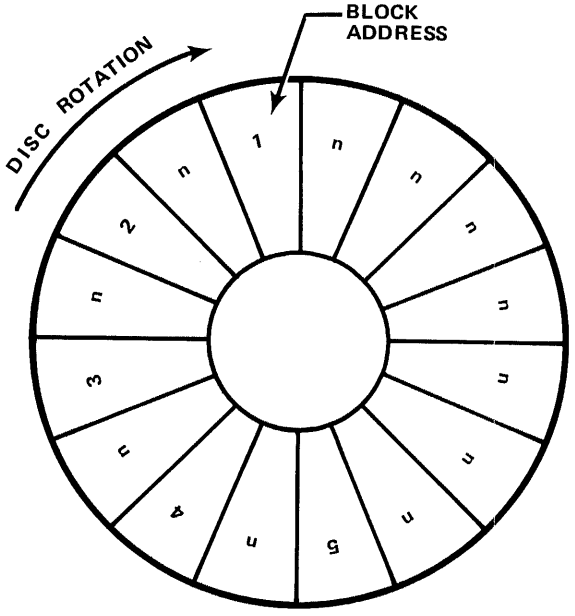


CASE 1

INTERLEAVE = 1

DATA TRANSFER SEQUENCE (BLOCKS 1 - n)

1. The disc unit reads and transmits block 1.
2. The disc head is now at block 2 but, because the host is still busy with the first transfer, the disc unit cannot read and transmit the second block.
3. The host finishes accepting block 1 and readies itself for block 2. By this time the disc head has passed the beginning of block 2 and the host will now have to wait for the disc to make a complete revolution back to this block. This induces a latency and degrades system throughput.



CASE 2

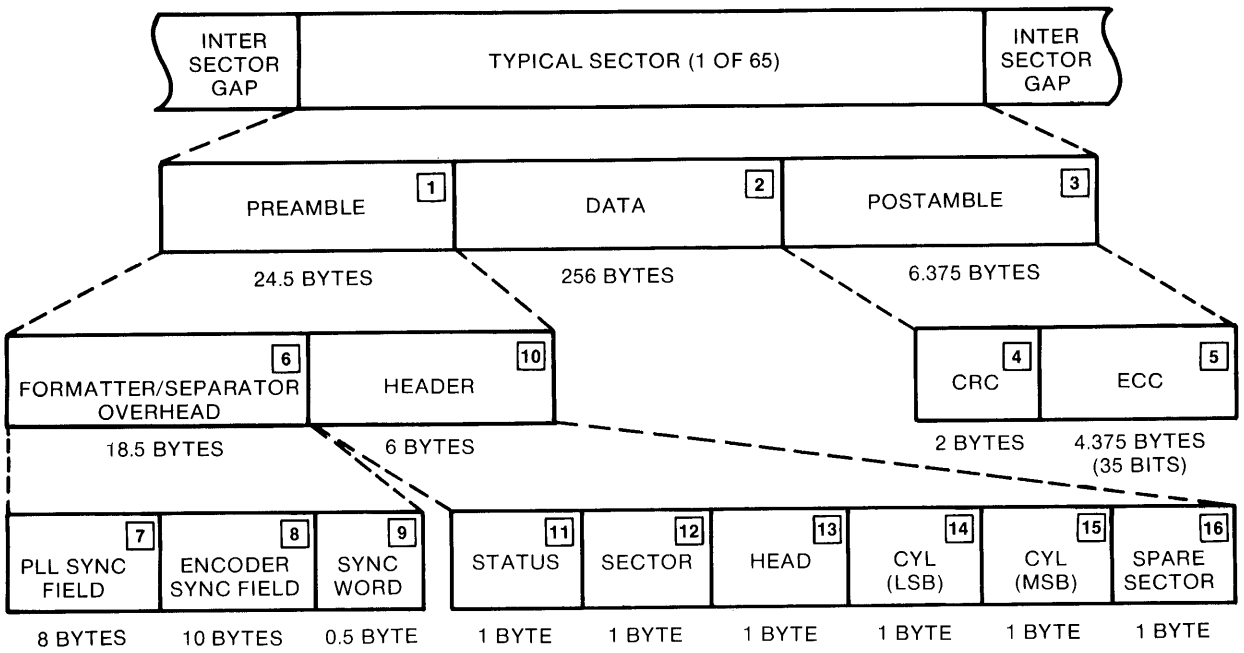
INTERLEAVE = 2

DATA TRANSFER SEQUENCE (BLOCKS 1 - n)

1. The disc unit reads and transmits block 1.
2. The host finishes accepting block 1 and readies itself for block 2. Because the blocks are interleaved, the disc head is over the intervening block and is approaching block 2.
3. The disc head arrives at block 2, and reads and transmits it to the waiting host. By using block interleave to alternate the data blocks, latencies have been reduced and system throughput has been enhanced.

5955-16B

Figure 3-3. Block Interleave



1	PREAMBLE	— 24.5 bytes for synchronizing and addressing.
2	DATA	— 256 bytes of data.
3	POSTAMBLE	— 6.375 bytes for data checking and error correction.
4	CRC	— Cyclic Redundancy Check. 16 bits for check information.
5	ECC	— Error Correction Code. 35 bits for check and correction information.
6	FORMATTER/SEPARATOR OVERHEAD	— 18.5 bytes to achieve synchronization.
7	PLL SYNC FIELD	— 8 bytes to achieve phase lock.
8	ENCODER SYNC FIELD	— 10 bytes for encode synchronization.
9	SYNC WORD	— 0.5 byte signalling start of data field.
10	HEADER	— 6 bytes for status and addressing information.
11	STATUS	— 1 byte for physical track status.
12	SECTOR	— 1 byte for sector address.
13	HEAD	— 1 byte for physical head address.
14	CYL (LSB)	— 1 byte for physical cylinder address (LSB).
15	CYL (MSB)	— 1 byte for physical cylinder address (MSB).
16	SPARE SECTOR	— 1 byte for logical spare address.

7912-34

Figure 3-4. Sector Format

The 24.5-byte preamble, which is used for synchronization and addressing purposes, is comprised of two fields: an 18.5-byte formatter/separator sync field and a 6-byte header field which specifies status, head, cylinder, and sector addresses, and provides the spare sector information.

The data field is used to store 256 bytes of data. Each byte is defined as being eight bits. Only the data field is transferred to and from the system during most data operations. The preamble and postamble are generated and checked by the controller.

The 6.375-byte postamble consists of a 2-byte cyclic redundancy check (CRC) word and 4.375 bytes (35 bits) of error correction code. The controller generates the CRC information during a write operation and appends it to the other information written in the sector. The check information itself depends on the value of every bit from the first bit in the header field to the last bit in the data field. During a read operation, this check information is regenerated and compared in such a way that the presence of errors is detected. The ECC circuitry can automatically, and with no delay, correct up to 12 contiguous bits per sector.

3-5. DISC SPARING

One sector per track and 8 tracks per data head are allocated for sparing bad sectors discovered during data transfers. When performing a sparing operation, the controller attempts a sector spare on the target address (sector). If the allotted spare sector has been used, the entire data track is spared. When sparing, the host has the option of retaining or not retaining data. If the host chooses not to retain data, all data on the target track is destroyed. If the host wishes to retain data, all data on the target track, excluding the bad sector, is kept.

3-6. SECTOR SPARING

When performing a sector sparing operation that retains data, the controller copies the entire contents of the target track (excluding the defective sector) to the nearest available spare track for temporary storage. The controller then reformats the original track, placing the spare sector into user accessible area and mapping out the bad sector. The data is then copied from the spare track back to the reformatted track with the bad sector being skipped. This shifts all those sectors with logical addresses greater than the bad sector to the next higher sector address. For example, assume that logical sector 4 is bad and has been spared out. After the track has been reformatted, sector 4 will be where sector 5 used to be, 5 will be where 6 used to be, etc. By reformatting the entire track in this manner, an additional latency is not incurred when accessing a track containing a spared sector.

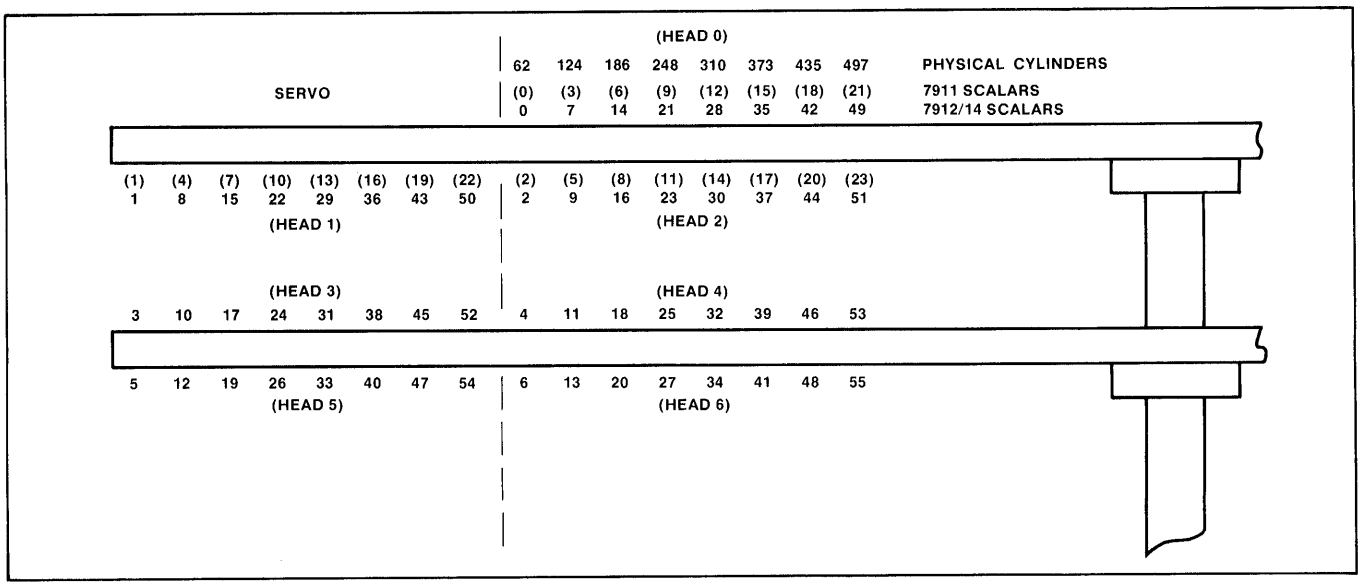
When reformatting the target track, the controller writes the logical address of the bad sector in the header of each sector on the track. Using this information, the controller knows which sector to skip in subsequent accesses to the track. On tracks that have not undergone a sector sparing operation, this field in the sector headers contains the logical address of the spare sector (logical sector 64 for all 791X drives).

3-7. TRACK SPARING

If the spare sector has been used, the controller must copy the entire track on which the defective sector resides to an available spare track. Each data head has eight spare tracks allocated for this purpose. Like data tracks, these spare tracks are organized into cylinders and, to improve sparing efficiency, are scattered across each data surface. A spare track table, which is stored in both controller RAM and on the maintenance tracks, contains the addresses of all tracks that have been spared along with the physical location of the new track. This table also contains a bit map showing which spare tracks are still available. To reduce the amount of controller RAM consumed by the spare track table, scalar values, rather than explicit addresses, are used to record the physical location of each spare track. Figure 3-5 shows the relationship of scalar values to physical spare track locations. Before performing a seek, the controller checks the spare track table to see if the target track has been spared. If it has, the scalar value corresponding to the physical location of the new track is read from the table and is used by the controller to locate the proper spare track. In this manner, all accesses to a spared track are redirected to the new track.

When performing a track sparing operation, the controller first determines the nearest (in terms of seek time) spare cylinder and then checks the spare table bit map to see if, within that cylinder, the spare track associated with the target head is available. If this track is not available, the controller searches the entire cylinder, beginning at head zero, looking for an available spare track. This technique, referred to as cross-head sparing, ensures that the nearest spare track, in terms of seek time, is used, even if that track resides on a different data surface. If there are no spare tracks available in the cylinder being searched, the controller begins a full search of the spare table looking for an available spare. This search starts with head zero of the outermost cylinder (scalar 0) and continues through each cylinder until a spare is located. Once a spare track has been located, the contents of the target track (excluding the bad sector) is copied to the new track and the spare table is updated to reflect the successful sparing operation.

Defective maintenance tracks are spared automatically by the controller. No host intervention is required when sparing a maintenance track.



7912-89

Figure 3-5. Spare Track Scalar Values

3-8. BLOCK LEVEL DESCRIPTION

The drive electronics consist of four functional systems: the read/write system, servo system, tape system, and power supply system. Mechanical systems will be discussed briefly. The block diagrams for both standard and dual controller drives are shown in figure 3-6.

3-9. READ/WRITE SYSTEM

The read/write system consists of circuits (see figure 3-6) on the disc memory access (DMA) printed circuit assembly (PCA) A4, microprocessor (UPROC) PCA-A3, read/write (R/W) PCA-A8, and part of the sealed disc mechanism. Under UPROC PCA-A3 control, the read/write system provides the means to read information from or write information to the data surface on the disc. Error correction is also provided in this system.

3-10. DISC MEMORY ACCESS PCA-A4. The DMA PCA-A4 read/write functions include: HP-IB interface to and from the disc, parallel/serial data conversion, and cyclic redundancy check (CRC) for error correction and data integrity. The main DMA output is serial nonreturn-to-zero (NRZ) data that is to be recorded on the disc, or byte parallel information for transmission over the HP-IB.

The HP-IB interface consists of 16 lines. Eight lines are data lines, three lines provide handshake operations, and the remaining five lines are used for bus management. (Refer to Section II, Channel Interface, for detailed information on the HP-IB lines.)

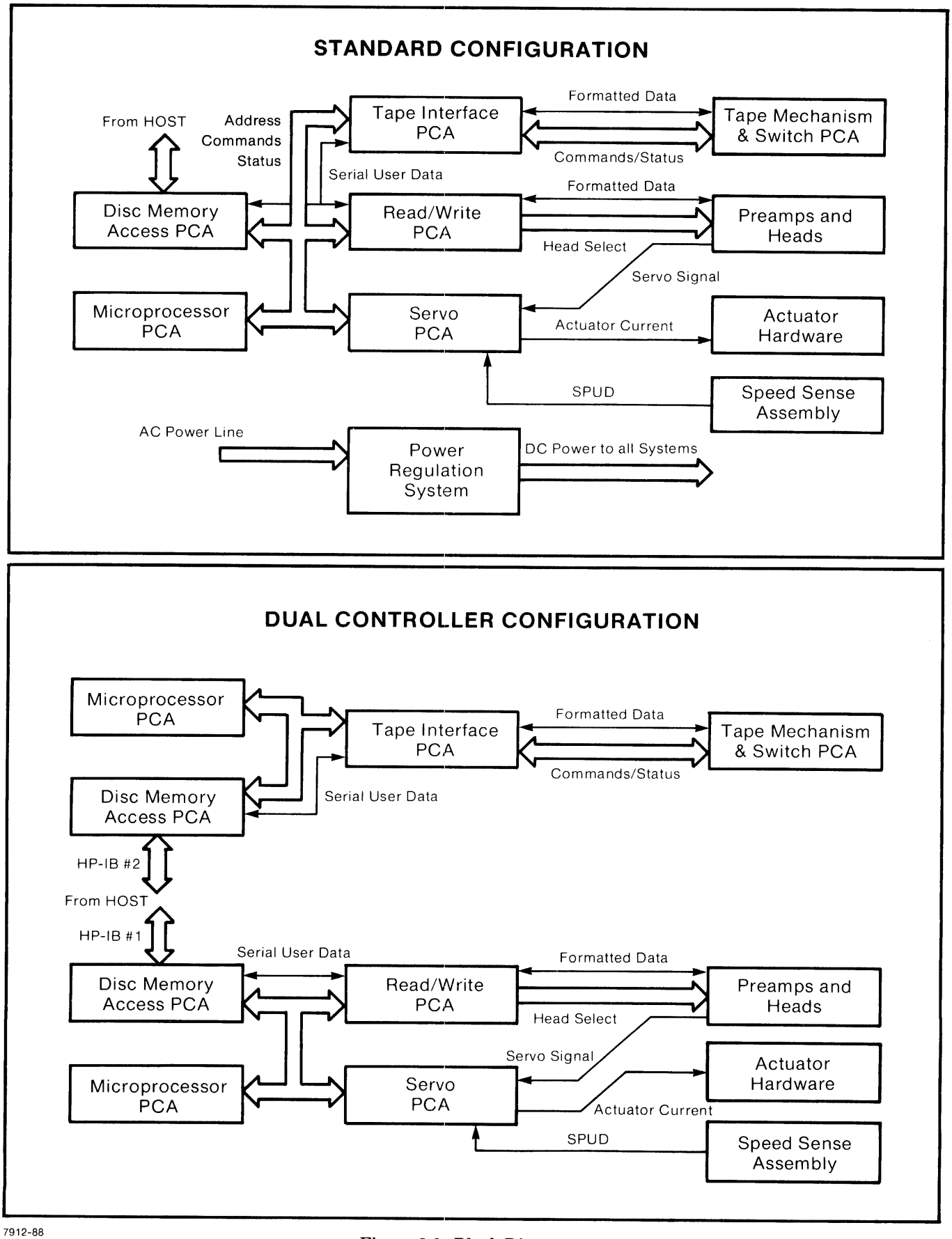
The DMA PCA-A4 interfaces to the UPROC PCA-A3 through 12 address lines (A0-H through A11-H), eight bidirectional data lines (D0-H through D7-H), and several select and control lines including Read (RD-L) and Write (WR-L).

Data transfers between the DMA PCA-A4 and R/W PCA-A8 are controlled by the Start of Sector (SOS-L), Start of Data (SOD-L), and Read/Write Clock (RWC-L). The Formatter/Separator Input (FIN-H), and Formatter/Separator Output (FOUT-H) lines are the data lines between these two PCA's.

3-11. READ/WRITE PCA-A8. The R/W PCA-A8 converts the DMA output (FIN-H) NRZ coded data into modified frequency modulation (MFM) data. This data (DX and DY) is sent to flex circuit PCA-A10 in the disc mechanism. During a read operation the MFM data from the disc mechanism (on DX and DY) is converted to NRZ data for use by the DMA PCA-A4. The R/W PCA-A8 also generates the Read/Write Clock (RWC-L) which is used to ensure proper sector format timing. Eight bidirectional data lines (D0-H through D7-H) carry signals from UPROC PCA-A3 to R/W PCA-A8 to control read/write operations. The sector timing pulse (STP-L) signal from the servo PCA-A9 determines when write operations should begin.

3-12. FLEX CIRCUIT PCA-A10. The portion of flex circuit PCA-A10 which functions within the read/write system uses two bidirectional lines (DX and DY) to carry the MFM data to and from the data heads. Several select lines are input from the R/W PCA-A8 to activate one of the data heads and set it in a read or a write mode. This PCA is within the sealed disc mechanism and is not accessible for service.

3-13. MICROPROCESSOR PCA-A3. The UPROC PCA-A3 controls the overall drive operation in response to input commands from the Controller-In-Charge (CIC). The inputs to UPROC PCA-A3 via the HP-IB and DMA PCA-A4 place the UPROC PCA into



7912-88

Figure 3-6. Block Diagrams

one of five operational categories: (1) control operations which include information transfer between the UPROC PCA and the CIC via the HP-IB and the DMA PCA; (2) sense operations which determine the state of UPROC PCA-A3 and the drive, and identify any error conditions that may have occurred; (3) write operations that control the transfer of data from the CIC to the disc; (4) read operations that control the transfer of data from the disc to the CIC; and (5) internal self test and diagnostics used to indicate drive operational status.

The UPROC PCA-A3 is interfaced to the DMA PCA-A3 by the A0-H through A11-H and D0-H through D7-H lines. The UPROC PCA-A3 generates the Read (RD-L) and Write (WR-L) control signals.

3-14. SERVO SYSTEM

The servo system consists of circuits (see figure 3-6) on the microprocessor (UPROC) printed circuit assembly (PCA) A3, servo PCA-A9, part of the sealed disc mechanism, and the speed sense assembly. Servo code is read from half of one disc surface which is dedicated to servo code. Signals derived from this code are used to control rotary actuator movement (head positioning), to control timing during data transfer operations, and to provide position information.

3-15. MICROPROCESSOR PCA-A3. During power-on, the UPROC PCA-A3 ensures that the heads are kept retracted until spindle rotation reaches the proper speed. This PCA also controls rotary actuator movement during seek operations and stores the track sparing tables which are read following a seek command to a spared track.

The UPROC PCA-A3 communicates with the CIC through the DMA PCA-A4 via eight bidirectional data lines (D0-H through D7-H). The commands received by the microprocessor enable it to control most other functions in the drive. The data lines are used within the servo system to pass various control signals and to report status. Twelve address lines (A0-H through A11-H) are used by the UPROC PCA-A3 to select various circuits depending upon the functions to be performed.

There are four major inputs from the servo PCA-A9: the Sector Timing Pulse (STP-L), Index (IDX-L), Track Crossing (TKX-L), and On Track (ONT-L). The STP-L pulse is used to count sectors during read and write operations; IDX-L is used as a reference pulse to indicate that physical sector zero is the next sector; TKX-L enables a single pulse for each boundary crossed between adjacent servo tracks during seek operations; and ONT-L is enabled when the servo head is centered within a small distance (window) on either side of the track boundary for the selected track.

Three signals from the microprocessor are output to servo PCA-A9: Read (RD-L) and Write (WR-L) are used to access latches on the servo PCA; Speed OK (SOK-H), a status signal, indicates that the spindle rotation is at the proper speed.

3-16. SERVO PCA-A9. The servo PCA-A9, under UPROC control, establishes and maintains proper head position. Several timing, status, and feedback signals are exchanged with the read/write system to ensure that data can be written to, or read from, the discs properly.

Interface lines between the servo PCA-A9 and the R/W PCA-A8 in the read/write system include: ONT-L, STP-L, Automatic Gain Control (AGC-L), Servo Clock (SCK), Seek (SEK-L), and Off Track (OFT-L). AGC-L and ONT-L (which also goes to UPROC PCA-A3) are used to indicate that the heads are in place over a valid track. Another pulse, STP-L (also used on UPROC PCA-A3), sets the timing for read/write sector transfers. The signal SCK is used to encode data and to generate various other read/write internal control signals. The SEK-L signal suspends read/write operations while a seek operation is in progress. A single input from the read/write system, OFT-L, is a fault line which indicates that the heads are not locked on a valid track.

3-17. FLEX CIRCUIT PCA-A10. The portion of the flex circuit PCA-A10 which interfaces the servo system with the sealed disc mechanism consists of six lines: Actuator Current Source (ACS), and Actuator Current Return (ACR) carry current to the rotary actuator from control circuits on the servo PCA; two output lines from the servo head to the servo PCA, Servo Preamp 1 (SP1) and Servo Preamp 2 (SP2) are the preamplified servo code lines; Compensation 1 (COMP1) and Compensation 2 (COMP2) are used in the HP 7914 to compensate for differences in servo head gap width.

3-18. SPEED SENSE ASSEMBLY. The speed sense assembly is a magnetic transducer that senses a pair of notches cut into the spindle drive pulley. The pulse train from the transducer is the Speed Up Don't Care (SPUD), is input to the servo PCA-A9. SPUD is a drive status line which is sampled on data line D7-H by UPROC PCA-A3. It is used only during power-on to hold the rotary actuator inactive until the spindle is up to speed.

3-19. TAPE SYSTEM

The tape system consists of circuits (see figure 3-6) on the disc memory access (DMA) PCA-A4, microprocessor (UPROC) PCA-A3, jumper PCA-A7, tape interface board (TIB) PCA-A6, switch PCA-A15, and the tape

module. If dual controller option 001 is installed, jumper PCA-A7 is removed and dedicated TIB DMA PCA-A1 and TIB UPROC PCA-A2 are installed. The tape system allows internal magnetic tape back-up for the discs via the jumper PCA. Under dual controller operation, disc back-up to the tape is via the system host.

3-20. DISC MEMORY ACCESS PCA-A4 OR TIB DISC MEMORY ACCESS PCA-A1 (TAPE CIRCUITS ONLY). Both these PCA's serve identical functions in the tape system; the difference being, when option 001 (dual controller) is installed, the Disc Memory Access (DMA) PCA-A4 is isolated from the tape system by removal of the jumper PCA, and the TIB DMA PCA-A1 is installed. The TIB DMA PCA is dedicated entirely to the tape system (no operations are shared with the disc system).

The functions of these PCA's include parallel/serial data conversion, HP-IB interface to and from the tape system, and the cyclic redundancy check (CRC) for data integrity on serial data transfers.

Sixteen lines are used to interface the DMA PCA (or TIB DMA PCA) to the HP-IB. Eight lines are data lines, three lines are for handshake operations with the HP-IB, and the remaining five lines are used for bus management (refer to Section II, Channel Interface, for more information). Interface with the UPROC PCA or TIB UPROC PCA consists of four address lines (A0-H through A3-H, or LA0-H through LA3-H, respectively), eight bidirectional data lines (D0-H through D7-H, or LD0-H through LD7-H, respectively), and several control and select lines (including the RD-L (LRD-L) and WR-L (LWR-L) select lines).

In standard drives, serial data transfers between the DMA PCA, disc, and tape in either direction are controlled by the Start of Sector (SOS-L), Start of Data (SOD-L), Read/Write Clock (RWC-L), DMA Input (DIN-H) and DMA Output (DOUT-H) lines.

In option 001 drives, serial data transfers between the TIB DMA PCA and the TIB PCA involve the same signal lines as in standard disc drives, except the lines are designated as "linked". For example, Start of Sector (SOS-L) becomes Linked Start of Sector (LSOS-L).

3-21. MICROPROCESSOR PCA-A3 OR TIB MICROPROCESSOR PCA-A2 (TAPE CIRCUITS ONLY). Both these PCA's control overall operation of the tape system in response either to input commands from the Controller-In-Charge (CIC) via the HP-IB, or to Save and Restore operations (disc-to-tape, tape-to-disc, respectively) initiated manually at the switch PCA. The commands can place the microprocessor in five operational categories: (1) control operations which exclude the transfer of data between the microprocessor and the HP-IB CIC; (2) sense operations which determine the state of the microprocessor and the tape system and identify the nature of any errors that may have occurred; (3) read operations which transfer data from the tape system to either the CIC or the disc system; (4) write operations which transfer data from either the CIC main storage or the disc system to the tape system; and (5) internal self-test and diagnostics. Disc-to-tape and tape-to-disc operations are not available in dual controller versions (Option 001) of the drive.

In standard drives the major lines which the microprocessor (UPROC) PCA uses to control the tape system include four address lines (A0-H through A3-H), eight bidirectional data lines (D0-H through D7-H), the Read (RD-L) and Write (WR-L) select lines, and the Counter Timer Chip Output (CTCO-H) timeout indicator. The CTC Trigger (CTCT-H) signal is an input signal from the tape interface board (TIB) PCA used to start the CTC.

In option 001 drives, signal lines are the same as those used in standard disc drives except that the lines are designated as "linked". For example, Read (RD-L) becomes Linked Read (LRD-L).

3-22. TAPE INTERFACE BOARD PCA-A6. The tape interface board (TIB) PCA performs basically the same functions for the tape system as the read/write PCA performs for the read/write system. These functions include: conversion of serial, non-return-to-zero (NRZ) coded data from the DMA PCA (or TIB DMA PCA) into modified frequency modulation (MFM) data, and writing, or reading, this data on the tape. The Linked Read/Write Clock (LRWC-L) is generated on this board to control timing involved in data transfer which, in turn, ensures proper format on the tape. During write operations these functions are reversed. In addition to the functions listed above, error correction logic is included on the TIB PCA to correct data during read and write operations. Interfacing operations with the switch PCA are also performed by the TIB PCA.

Major lines which connect the TIB PCA with the UPROC PCA (or TIB UPROC PCA) are: four address lines (LA0-H through LA3-H); eight bidirectional data lines (LD0-H through LD7-H); two select lines, Linked Read (LRD-L) and Linked Write (LWR-L); and two signal lines, Linked CTC Output (LCTCO-H) and Linked CTC Trigger (LCTCT-H).

Connections to the DMA PCA (or the TIB DMA PCA) include Linked Read (LRD-L), Linked Write (LWR-L), Linked DMA Input (LDIN-H), Linked Start of Sector (LSOS-L), Linked Start of Data (LSOD-L), and Linked Read/Write Clock (LRWC-L). The Linked DMA Output (LDOUT-H) line is an output from the TIB PCA to the DMA PCA (or the TIB DMA PCA).

Status and control lines between the TIB PCA and the switch PCA are Lamp 1 (PROTECT indicator), Lamp 2 (BUSY indicator), Switch 1 (SW-1 - SAVE switch), Switch 2 (SW-2 - RESTORE switch), and Switch 3 (SW-3 - UNLOAD switch).

Tape module connections to the TIB PCA include eight command bus lines (CMD00 through CMD07); eight status lines (ST00 through ST07); Command Strobe and Command Acknowledge (CSTROBE-H and CACK-H); Status Strobe and Status Acknowledge (SSTROBE-H and SACK-H); Read/Not Write Enable (RNWEN - read-high, write-low); Read Data (RDDATA); and Write Data (WRDATA).

3-23. TAPE MECHANISM. The tape mechanism contains the mechanical and electronic hardware necessary to write data to or read data from the tape. Control is provided for the capstan drive motor and the movable read/write head. The movable read/write head allows alternate direction recording on 16 adjacent tracks (serpentine fashion). Interconnecting lines are listed in the discussion for the TIB PCA.

3-24. SWITCH PCA-A15. The three switches and two indicators on this PCA provide operator and service interface to the tape system. The switches provide a means of removing the tape cartridge (UNLOAD), backing up the disc onto the tape (SAVE), and restoring the disc from the tape (RESTORE). The latter two switches are provided for use by service personnel. Two light-emitting diodes (LED) indicate if the tape is write protected (PROTECT) and if the tape mechanism is currently active (BUSY).

3-25. POWER SUPPLY SYSTEM

The power supply system consists of power regulator PCA-A13 (see figure 3-6) and various discrete components which rectify and filter the ac input voltage. Regulated and unregulated voltage supplies are located on the power regulator PCA. Induction motor start circuitry for the disc mechanism spindle motor is provided by discrete components within the power rectifier circuitry.

Inputs to the regulator PCA from the power rectifier circuitry include three unregulated dc voltages: +11.5V, +20V, and -20V. A single input from the motherboard PCA is the voltage level sense line (+5 SEN). This signal allows the regulator PCA to monitor the current state of the +5V line.

Outputs from the regulator PCA include: unregulated -20V to the disc mechanism spindle motor brake; regulated +5 VA (20 ampere line) and +12V to the tape module; and regulated voltages to the motherboard PCA for distribution throughout the drive. Regulated voltages to the motherboard PCA are: -20V, -12V, -5.2V, -4V, +5 VA, +6V, +12V (separate from the +12V to the tape module), and +20V. In addition to voltage supplies, Possible Power Fail (PPF-L) and Master Reset (MRST-L) signals are output to the motherboard PCA.

3-26. MECHANICAL SYSTEMS

In addition to the electronic systems, the drive contains six mechanical systems: disc mechanism spindle drive, spindle brake, air cooling, air filtration, vibration protection, and rotary actuator.

3-27. DISC MECHANISM SPINDLE DRIVE SYSTEM. The disc mechanism spindle drive consists of an ac induction disc spindle motor, a drive pulley, belt, and spindle pulley. Optional 50 Hz disc drives use a different drive pulley and belt than the standard disc drives to maintain the proper spindle speed of 3,600 rpm (±15%). The disc spindle motor contains an internal thermal switch which cuts off current to the motor if it should overheat.

3-28. SPINDLE BRAKE SYSTEM. The disc spindle motor uses an internal "disc" style brake to stop spindle rotation when power is lost. A metal disc brake is retracted from the braking pad by -20 volts from the power regulator PCA-A13. If power is removed, the pad contacts the disc brake to stop spindle rotation.

3-29. ROTARY ACTUATOR. The rotary actuator uses control signals from the servo system to position the read/write heads in a rotary fashion, similar to a tone arm on a record player. If spindle speed drops below 3,060 rpm, the heads are retracted by spring tension into the "landing zone", an area free of any recorded data.

3-30. AIR COOLING SYSTEM. The cooling system uses the disc spindle motor to drive a blower wheel mounted on the motor shaft opposite the drive pulley. This blower wheel pulls outside air through the lower card cage, then pushes the air through the power box and out the rear panel (see figure 3-7).

3-31. AIR FILTRATION SYSTEM. A port on the side of the disc mechanism filtration unit takes a small quantity of the air moving through the blower wheel, filters this air, and ducts the air via a flexible tube to the hub of the spindle. This air equalizes the pressure inside the disc mechanism to prevent damage to a fluid seal within the mechanism. A second filter in the filtration unit cleans and recirculates air inside the mechanism.

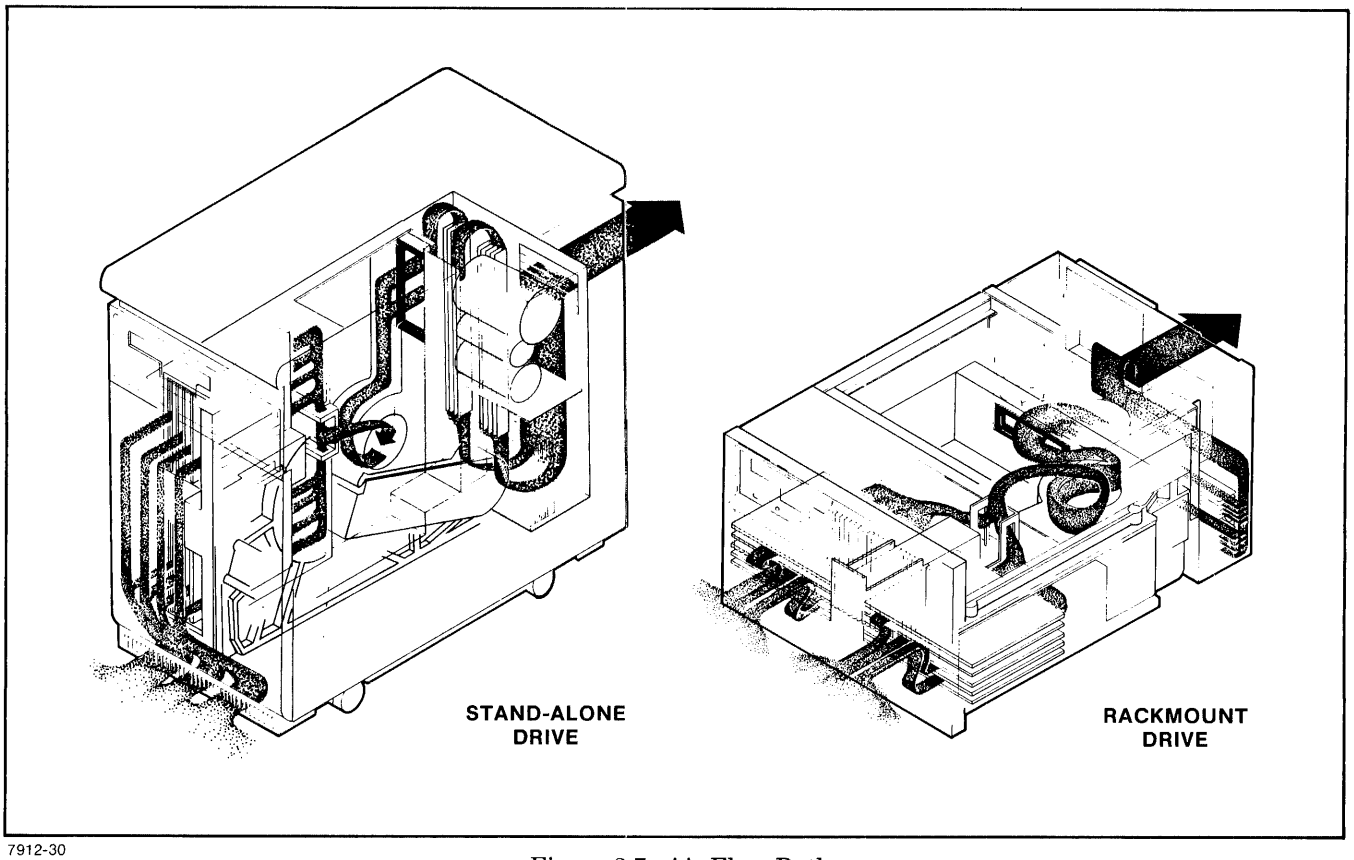


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Figure 3-7. Air Flow Path

3-32. VIBRATION PROTECTION. Rubber shock mounts (see figure 6-1, item 47 or figure 6-2, item 28) isolate the disc mechanism from the mainframe to reduce vibration and the effects of movement which could be harmful to the read/write heads, the discs, or to data transfer operations.

3-33. DETAILED OPERATION

The following paragraphs describe the theory of operation of each of the functional systems. The theory is discussed at the detailed block level with individual circuits described more fully when necessary to understand the operation being performed.

Overall interconnection of the major signal lines is shown in service sheets 1 and 2 (figures 4-9 and 4-10). A detailed description of each system will be discussed later in this section of the manual, supported by complete signal interconnection diagrams for each system. Each functional block diagram is labelled with a bold number. This number is used to direct the user from diagram to diagram. The mainframe wiring diagram is included in service sheet 7 (figure 4-27). An alphabetic listing of each signal mnemonic, and a source and destination list is provided in Section IV, Service Information.

3-34. READ/WRITE SYSTEM

The read/write system, (see service sheet 3, figure 4-14) performs data transfers to (write) and from (read) the disc. The read/write system consists of circuits located on the microprocessor (UPROC) PCA-A3, the disc memory access (DMA) PCA-A4, the read/write (R/W) PCA-A8, and the flex circuit PCA-A10 (located inside the sealed disc mechanism). The following paragraphs explain the read/write system operation and its circuits.

3-35. WRITE OPERATION. To begin a write operation, the CIC outputs write command information to the disc via the HP-IB. The DMA PCA-A4 separates and routes this information to the UPROC PCA-A3 which prepares the read/write system for a write operation. Data transfer then begins via the HP-IB lines. The DMA PCA-A3 outputs the header information (preamble) to the UPROC PCA-A3 where it is used to control the servo system. At the same time, the DMA converts the parallel data into serial NRZ data, then checks the NRZ data for errors and corrects it (if possible). The serialized, corrected data is coupled to the read/write PCA-A8.

Once on the R/W PCA-A8, the NRZ data is coded into an MFM differential signal. Timing signals control the R/W PCA to ensure that the data is written in

proper sector format at the proper time. Inputs from the UPROC PCA determine the location on the disc where the MFM data is to be written. The MFM data lines and various select lines are tied to the flex circuit PCA-A10 which selects the proper data head and passes the data to this head to be written.

3-36. READ OPERATION. When the CIC selects the disc system for a read operation, the command information is output to the DMA PCA-A4 via the HP-IB. The DMA separates and routes this information to the UPROC PCA-A3 which prepares the read/write system for a read operation. A portion of the command information on the HP-IB designates the address (cylinder, head, and sector) of the data it wants to read.

The servo system (refer to paragraph 3-71) performs seek and track following operations, under control of the UPROC PCA-A3, to properly position the data heads. Select lines on the R/W PCA-A8 enable head select logic on flex circuit PCA-A10 to read from the appropriate data head. This data is passed back through the flex circuit PCA where preamplification of the coded data occurs. The MFM coded data is then passed to the R/W PCA-A8 over the DX and DY lines. The MFM data is converted to NRZ data in the read chain circuits and sent to the DMA PCA-A4.

Incoming data on the DMA PCA-A4 undergoes error correction and CRC operations before being converted from serial NRZ data into parallel data. Once this conversion occurs, header and trailer information is stripped from the block of data. The block of data is transmitted to the CIC over the HP-IB lines to complete the read operation.

3-37. MICROPROCESSOR PCA-A3. The microprocessor (UPROC) PCA read/write control circuits consist of the following: Z80 CPU, ROM, RAM, Hex Display, Decode Logic, Counter-Timer Chip (CTC), Multiplexer, and Control Logic. The Speed Check and Tape Counter blocks are shown, but are not used in the read/write system.

3-38. Z80 Central Processing Unit (CPU). The Z80 CPU is the control center for read/write system operation. It controls all HP-IB byte transfers to the disc. Address, command, and control information from the Controller-In-Charge (CIC) is decoded and used to output various signals to the read/write system via the control lines and the address and data buses. During data transfers the Z80 CPU counts the number of 16 sector blocks passing through the DMA PCA.

3-39. Read-Only Memory (ROM). Programs stored in ROM translate the information received by the Z80 CPU into microcode instructions which the Z80 CPU can then use to control the disc mechanism.

3-40. Random Access Memory (RAM). Program variables are temporarily stored in this memory. When the Z80 addresses the RAM via the address bus (A0-H through A11-H), information can be written to, or read from, the RAM on the data bus (D0-H through D7-H). Track sparing information stored on the disc maintenance tracks is written into RAM during power-on sequences.

3-41. Hex Display. A seven-segment light-emitting diode (LED) display provides a user interface to the self-test routines and diagnostics. Coded status of the drive is displayed here. For more information regarding self test and diagnostics, refer to Section IV, Service information.

3-42. Decode Logic. Select signals used to access other boards are generated here by decoding address bus inputs. These select signals can also enable appropriate circuitry on individual boards for a spcific operation.

3-43. Counter-Timer Chip (CTC). The CTC contains four programmable counter/timers, each of which is capable of generating an interrupt to the Z80 CPU. One of these counters uses the Sector Timing Pulse (STP-L) signal from the servo system to count sectors during read/write firmware routines.

3-44. Multiplexer. The Multiplexer provides an interface to the Z80 CPU from the service switches used to initiate self test or diagnostic routines. For more information on these routines, refer to Section IV, Service Information. The On-Track (ONT-L) signal is also input to the multiplexer. During seeks, this signal is used by the UPROC to determine when the target track has been reached.

3-45. Control Logic. Control signals received from the Z80 CPU allow this circuit to generate the Read (RD-L) and Write (WR-L) signals. These two control signals set the read/write system in the proper mode of operation. Master Reset (MRST-L) resets the control logic to a power-on state.

3-46. DISC MEMORY ACCESS (DMA) PCA-A4. The DMA PCA read/write system circuits consist of the following: PHI and PHI Latch, Byte Control, Data Counter, Processor Interface, Header RAM, Data RAM, SERDES, CRC, Disc/Tape Interface, and Error Correction Code (ECC).

3-47. Processor to HP-IB Interface (PHI) and PHI Latch. Under Z80 CPU control, the PHI and PHI latch transfers parallel bytes of information across the Hewlett-Packard Interface Bus (HP-IB).

Data is transferred from the HP-IB to the data RAM during write operations, and in the reverse direction for a read operation.

The PHI acts as a buffer for all HP-IB signals in and out of the DMA PCA. The PHI latch is a holding register for one byte accompanied by two control bits. The control bits are decoded to determine whether the byte is data, a secondary command, or the last data byte (during a read operation). The PHI latch has to do a cycle steal (take control) from the disc controller to allow time for data transfers by the PHI.

3-48. Byte Control. Two ROM-based state machines control all data byte movement in the DMA PCA. One state machine controls data transfers between the PHI, data RAM, and SERDES; the other state machine controls data transfers between the PHI and PHI Latch. The Byte Control prevents incoming data from overrunning the Data RAM. It accomplishes this during a read by holding the data transfer until one whole sector is read from the disc. During a write, data transfer is delayed until a full sector is available in Data RAM.

3-49. Data Counter. Three counters comprise the data counter: an input/output (I/O) address counter, an I/O byte counter, and a disc address counter. The I/O address counter addresses the data RAM during PHI and data RAM transfers. Before each data transfer between the drive and the host begins, the UPROC loads the I/O byte counter with the number of bytes contained in the transfer. As the transfer progresses, the I/O byte counter counts each byte transferred over the HP-IB and, when the required number is reached, the UPROC is alerted to stop the transfer.

The disc address counter is a 13-bit counter used to address the header RAM and data RAM during data transfers between the DMA and the disc. During the transfer of each sector, the lower nine bits of the counter are used to address the two RAM's in the following sequence: six bytes of header RAM (header), 256 bytes of data RAM (data field), and seven bytes of header RAM (postamble). The four most significant bits of the disc address counter are used to determine which of the sixteen 256-byte blocks of data RAM will be addressed during the data transfer. These four bits allow the UPROC to alter the sequence of sectors tranferred; a useful feature when sector interleaving is used.

3-50. Processor Interface. Select and control lines from the microprocessor PCA are input to the DMA PCA via this block. Inputs include three select lines, two control lines, eight bidirectional data lines, and twelve address lines. The select lines are: DMA Select (DMAS-L) which allows the microprocessor access to the byte control; Buffer Select (BUFS-L) which allows the microprocessor access to the data RAM; and Input/Output Select (IOS-L) which allows the microprocessor access to the PHI. The Read (RD-L) and the Write (WR-L) control lines provide operational mode control. Data lines D0-H through D7-H provide additional control lines and status feedback for the microprocessor. The address lines (A0-H through A11-H) are used to access various circuitry throughout the disc and tape modules.

3-51. Header RAM. Preamble and postamble information (see figure 3-4) is stored in this block. Header information is stored in the lower six bytes of Header RAM. The header contains disc address and status information. The upper seven bytes of postamble information consist of two bytes of Cyclic Redundancy Check (CRC) bits and five bytes of Error Correction Code (ECC) bits. During a disc write operation, the ECC bytes are replaced by ECC information generated by the ECC circuit located on the DMA PCA.

3-52. Data RAM. All data to or from the disc, tape, or CIC must pass through this buffered storage. Up to 16 sectors, each containing 256 bytes, can be stored here at one time.

3-53. Serializer/Deserializer (SERDES). Two registers, one a holding register and one a shift register, change parallel bytes to serial bit data during a write operation and reverse the process for read operations.

3-54. Cyclic Redundancy Check (CRC). This circuit is both a checker and a generator for CRC information. During a write, the contents of the Data RAM is clocked through the CRC block and 16 bits of CRC is appended at the end of each sector. During a read, the serial data is clocked through, checked, and if no errors are detected the CRC will be filled with all logic zeroes. If an error is detected, as indicated by any logical 1 bit, the CRC will flag the data as having a CRC error.

3-55. Disc/Tape Interface. This is the serial data interface to the ECC circuitry and to the tape system. Five lines provide the data path and control for transfer of data. The DMA Input (DIN-H) and DMA Output (DOUT-H) are the serial data lines between this circuit and the ECC circuit in the read/write system. When enabled, Start of Sector (SOS-L) and Start of Data (SOD-L), tell the DMA PCA to get ready to transfer and start data transfer, respectively. A timing pulse, Read/Write Clock (RWC-L) clocks data in and out of the disc/tape Interface.

3-56. Error Correction Code (ECC). The ECC improves the integrity and recoverability of data on

the disc. To do this, 35 bits of redundant information are generated from the data, then appended to the end of the data. When the data is read from the disc, the ECC block determines if an error occurred (during the write operation) and corrects the data if the error is 12, or less, sequential bits. More than 12 sequential bits in error will be detected, but not corrected. ECC status is sent to the microprocessor PCA and in return receives control information. The Formatter/Separator Input and Output (FIN-H and FOUT-H) are the serial data lines between the ECC and the read/write PCA-A8.

3-57. READ/WRITE (R/W) PCA-A8. The R/W PCA is responsible for writing to, and reading data from the disc media. A description of the functional block follows.

3-58. Read/Write (R/W) Control and Fault Detection. This circuitry performs numerous functions on the R/W PCA. Communication between the R/W PCA and UPROC PCA occurs via the data bus lines (D0-H through D7-H). Two select lines, R/W Select (RWS-L) and Formatter/Separator Select (FSS-L), and two control lines, Read (RD-L) and Write (WR-L), sent from the UPROC PCA enable the proper circuitry and mode for a given operation.

Inputs on the data lines enable this circuitry to control head selection and write current. Four signals are generated on the R/W PCA to control head selection: Chip Enable 0 and 1 (CE0-L and CE1-L), Head Select 1 and 2 (HS1 and HS2). The Write Select 0 and 1 (WS0 and WS1) signals control the application of write current to the appropriate data head during a write operation. Two additional signals, WCV-L and EWC-L, are output to the write current driver to control head current during a write.

This block accepts two resets: power-on Master Reset (MRST-L) is generated on the regulator PCA; Reset Select (RES-L) is generated by the microprocessor PCA and produces a general reset on the R/W PCA. The Seek (SEK-L) line from the servo system is used to indicate to the R/W system that the disc mechanism is in a seek mode; therefore, a read or write should not be attempted.

Three status lines are input to this block: Unsafe Current (US-H), input from the flex circuit PCA, indicates that write current exists in the data heads during a read mode, or that there is a malfunction in the heads (such as a shorted coil); Automatic Gain Control (AGC-L) and On Track (ONT-L), from the servo system, indicate that the heads are over a valid track. Three signals are output to the servo system fault latch: Write and Off Track (WOT-L), Off Track (OFT-L), and Destructive Write Fault (DWF-L). When asserted, DWF-L disables write current to the data heads.

3-59. Self-Test Buffer. This circuit monitors the states of two on-board signals: Write Enable (WTEN-H) and Enable Self-Test (EST-L). When addressed by the microprocessor (SEL-L enabled), the buffer will place the current state of these signals on the data bus. An additional input to the self-test buffer is the Fourteen Identify (FIND-L) signal which allows the microprocessor to determine whether or not the drive is an HP 7914. In an HP 7914, this signal is enabled (grounded) on the motherboard PCA-A11 (see service Sheet 1).

3-60. Write Current Driver. This circuit provides a current sink for write current returning from the heads. The SSI chip gates the current supplied by the center tap driver through the correct side of the selected head and returns it to the R/W board via the WC line. Enable Write Current (EWC-L) turns the driver on. Master Reset (MRST-L) disables the write current driver any time a reset condition occurs.

In addition to enabling the write current, this circuit also controls the magnitude of the current to the data heads. Because the inner heads "fly" closer to the disc surface than the outer heads, less current is required when writing on the inner bands. When an inner data head is selected, the microprocessor asserts the Write Current Value (WCV-L) signal (data line D3-H) which reduces the write current to the appropriate data head. The increased track density on the HP 7914 requires a further reduction in write current to both inner and outer heads. The Drain Off Write Current (DOWC-L) signal provides this reduction. In an HP 7914, this line is enabled (grounded) on the motherboard PCA-A11 (see service sheet 1).

3-61. Write Interface. This block of circuitry accepts the nonreturn-to-zero (NRZ) serial data stream from the DMA PCA (FIN-H). Using a clock input from the control timing generator (RWC-H), the interface establishes the correct relationship between the incoming data and the clock edges, and outputs the resultant data stream to the MFM formatter.

3-62. Modified Frequency Modulated (MFM) Formatter. In this block, NRZ data from the write interface is encoded into MFM data which allows greater data packing density. In MFM encoding, a transition occurs in the center of each logical "1" bit, and at the boundary of two adjacent logical "0" bits (see figure 3-8). The Servo Clock (SCK) input from the Servo PCA, together with two signals generated by the control timing generator (SOD-H and RWC-H), are used to produce the proper timing. In addition to the MFM output, this block also produces a timing signal (BCLK) which is derived from SCK and is used by both the control timing generator and the separator input switch.

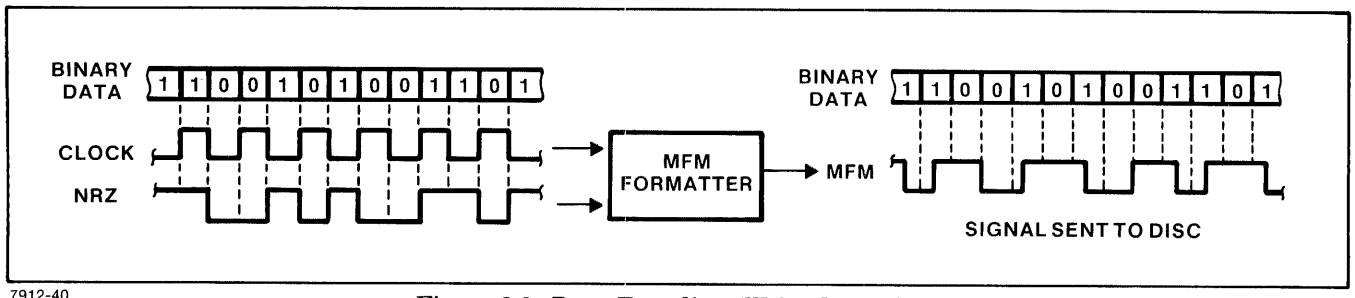

Figure 3-8. Data Encoding (Write Operation)

The formatter also includes precompensation circuits to offset the effects of bit shift in certain data patterns. Bit shift occurs when a logical transition is phase-shifted because of the effects of adjacent bits.

3-63. Write Chain. The write chain converts the MFM data output of the MFM Formatter into a differential data signal. The differential data is output to the flex circuit PCA via the Differential Data X and Y (DX and DY) lines.

3-64. Control Timing Generator. The timing generator uses inputs from the MFM formatter (BCLK), the MFM separator (SDO-L and RCLK), and the R/W control (KSTP) to generate the timing control signals necessary to ensure correct performance during read or write operations. Outputs from the generator control the operating mode of the phase-locked loop (LMD), the output of the separator input switch (RWMUX), and the bit-rate clock for several other R/W circuits (RWC-H). Two additional signals are output to the DMA PCA: Start of Data (SOD-H) indicates that the next RWC-L transition marks the beginning of the data field; Start of Sector (SOS) indicates that the data field will begin within 50 microseconds.

3-65. Read Chain. Low amplitude differential data read from the disc (DX and DY) serve as the input to the read chain. Here the data is amplified to a 2.8 volt peak-to-peak differential signal whose zero-crossings mark transitions in the MFM encoded data stream. An Automatic Gain Control (AGC) voltage is used to maintain a constant signal amplitude. The two components of the differential signal (visible at test points PD and ND) are processed to produce TTL pulses corresponding to the zero-crossings. These pulses (DAT) provide one of the inputs to the separator input switch.

3-66. Separator Input Switch. The RWMUX signal selects either the output of the read chain (DAT) or a servo-based clock signal (BCLK) as the input (DATA) to the phase-locked loop. During write or seek operations, BCLK is selected; when not writing or seeking, DAT is selected.

3-67. Phase-Locked Loop (PLL). The PLL contains a voltage-controlled oscillator (VCO) which is locked to one of two input signals depending on what operation the drive is currently performing. During seeks or writes, the VCO is locked to a servo-based clock (BCLK) generated by the MFM formatter; this is the phase/frequency mode of PLL operation. When the drive is not seeking or writing, the output data pulses from the read chain (DAT) serve as the input to the VCO; this is the phase detector mode of operation. The mode of PLL operation is controlled by a signal from the control timing generator (LMD). The PLL outputs two signals to the MFM separator: data pulses (DATS) and the clock necessary for recovering the data (PLL CLK).

3-68. MFM Separator. The logic used to convert the MFM output of the PLL (DATS) is located here. The Separator Data Output (SDO-L) is the recovered NRZ data. The separator also generates a Read Clock (RCLK-H) which, after being multiplexed through the control timing generator, is output to the DMA PCA as the reference bit rate clock (RWC-H).

3-69. Read/Write Output Buffer. There are several signals that control the data flow between the R/W PCA and the DMA PCA. These signals are output to the DMA by the R/W output buffer, a 3-state buffer that is enabled by the Microprocessor PCA (DEV-L) in preparation for each data transfer. There are four signals output by the buffer: Start of Sector (SOS-L), Start of Data (SOD-L), Formatter Output (FOUT-H), and the Read/Write Clock (RWC-L).

3-70. FLEX CIRCUIT PCA-A10. One (in HP 7911 models) or two (in HP 7912 and HP 7914 models) logic chips are located on this PCA which is inside the sealed disc mechanism. Using inputs from the R/W PCA, these chips establish the proper mode of operation (read or write) and select the appropriate data head. When reading, data is preamplified by these chips before being output to the R/W PCA via the DX and DY differential data lines.

3-71. SERVO SYSTEM

The servo system (see service sheet 4, figure 4-16) performs three functions: seek, track following, and fault detection. The servo system consists of circuitry on the UPROC PCA-A3, the servo PCA-A9, and the flex circuit PCA-A10. The following paragraphs explain the servo system operation and circuits.

3-72. SEEK. Upon receipt of a Locate and Read or a Locate and Write command from the CIC, the UPROC PCA-A3 checks the track address at the present location of the servo head. If the present address is different from the new address, the UPROC PCA checks to determine if the track has been spared and uses the spared track address, if necessary. The Z80 CPU then transfers the necessary seek information to the servo latch. The servo PCA asserts the Seek (SEK-L) signal which will disable the read/write system during the seek operation. Under servo PCA control, the Actuator Current Source (ACS) line causes the rotary actuator to accelerate the heads rapidly for the first half of the seek, and decelerate during the second half of the seek. The Track Crossing (TKX-L) pulse is fed back to the UPROC PCA which allows the Z80 CPU to determine head position and velocity during the entire seek operation. At the end of the seek, the heads will go into the track following mode for the read or write operation.

3-73. TRACK FOLLOWING. As the rotary actuator nears the end of deceleration in a seek operation, the track following operation begins. When the servo head is within about one-quarter of a track from the track it was seeking, UPROC PCA-A3 outputs a Fine Servo (FSR) signal to the servo PCA-A9 on data line D2-H. This closes the servo loop to lock the servo head on track. Once the heads are settled on track, the ONT-L signal is asserted to inform the read/write PCA that disc access operations may now begin.

3-74. FAULT DETECTION. The fault register on the servo PCA-A9 functions as a collecting point for faults from throughout the drive. When addressed by the UPROC PCA, the register outputs the fault signals on the data bus (D0-H through D7-H). If a fault is detected, the UPROC takes appropriate action based on the nature of the fault.

3-75. MICROPROCESSOR PCA-A3. The microprocessor (UPROC) PCA servo control circuits consist of the following: Z80 CPU, ROM, RAM, Decode Logic, Speed Check, CTC, Multiplexer, and Control Logic.

3-76. Z80 Central Processing Unit (CPU). The Z80 CPU is the control center for servo operations. Address and command information from the Controller-In-Charge (CIC) via the DMA PCA is decoded and used to initiate seek operations. Address information used to select specific circuitry is generated here. Eight bidirectional data lines carry control and status information to and from the Z80 CPU.

3-77. Read-Only Memory (ROM). Microcode program information is stored here. This information is used to translate CIC commands into instructions that the Z80 CPU understands.

3-78. Random Access Memory (RAM). This portion of memory provides temporary storage of program variables. Track sparing tables are also stored here and are loaded into the RAM from the disc maintenance tracks during power-up.

3-79. Decode Logic. The Servo Select (SERS-L) signal is used to access the servo PCA, and is generated by decoding the Z80 CPU address bus (A0-H through A11-H).

3-80. Speed Check. The Sector Timing Pulse (STP-L) input from the servo PCA is used to check the disc speed after power-on sequences. A Speed OK (SOK-H) signal is generated by this circuit and output to the fault register on the servo PCA. The Z80 CPU then uses this fault signal to determine when the heads can be moved across the disc surfaces.

3-81. Counter-Timer Chip (CTC). The CTC contains four programmable counter/timers, each capable of generating the interrupt (INT-L) to the Z80 CPU. One counter is triggered by the Track Crossing (TKX-L) pulse and is used by the firmware during seek operations in both the disc and the tape modules. The STP-L signal input allows the CTC to count sectors on the disc when seeking to a given address.

3-82. Multiplexer. This circuit gates the Index (IDX-L) and On Track (ONT-L) pulses to the Z80 CPU which uses these signals in determining logical position on the disc.

3-83. Control Logic. Through signals received from the Z80 CPU, the Read (RD-L) and Write (WR-L) control signals are generated by the control logic. Operational modes are set throughout the disc and tape modules by these two signals.

3-84. SERVO PCA-A9. The servo PCA circuits consist of the following functional blocks: the Servo Filter/Amplifier, "PRE" Level Detector, Peak Detectors, Sector Timing/Index Mark Detector, Phase

Locked Loop, Automatic Gain Control, Position Error Amplifier, Track-Crossing Detector, Track-Center Detector, Track Follower Latch, Offset Generator, Servo Latch, Reference Amplifier, Seek Logic, Actuator Control, Latch Select, Fault Register, and Master Reset Buffer. Operation of these circuits is described below.

3-85. Servo Filter/Amplifier. The low-level, differential servo head output is amplified by circuitry inside the sealed disc mechanism and then input to the servo filter/amplifier circuitry as the Servo Preamp 1 (SP1) and Servo Preamp 2 (SP2) signals. High frequency noise is filtered out, then the signals are input to an amplifier whose gain is controlled by the Automatic Gain Control (AGC) circuitry. This maintains a constant output signal regardless of the input signal level. The output from this amplifier is again filtered and amplified to become the single-ended signal "PRE".

3-86. PRE Level Detector. This circuitry detects the presence of the PRE signal and converts this signal to digital pulses. Outputs from this detector are input to the Phase-Locked Loop (PLL) and the sector timing/index mark detector.

3-87. Peak Detectors. This circuit contains two peak detectors (A and B), that detect and store the positive peaks of the PRE signal. Each peak detector stores only the peaks associated with one of the two adjacent servo tracks being read by the servo head. Only one detector at a time is enabled; a 1.56 MHz clock signal from the PLL and a select signal (LSB) from the track follower latch control the detector timing. The amplitudes of the detector outputs, relative to one another, indicate the position of the heads.

The servo tracks are formatted so that the servo code flux transitions on adjacent tracks occur during different time intervals (see figure 3-9). Timing circuitry within the detector block ensures that the individual detectors are enabled during the proper time intervals. The proper timing is determined by the state of LSB which indicates whether the heads are servoing on an "even" (LSB=0) or "odd" (LSB=1) track. In either case, the detector timing ensures that the B peak detector will always detect the servo code on the outer of the two servo tracks being read. Thus, if the B detector output is higher than normal, the heads must be moved toward the inside of the disc. Conversely, because the A peak detector always detects the servo code on the inner track, the heads must be moved toward the outside of the disc if the A detector output is higher than normal.

The peak detector circuitry also outputs a 780 kHz clock signal which is used by the sector timing/index mark detector and the PLL.

3-88. Sector Timing/Index Mark Detector. This detector uses a 780 kHz clock signal from the peak detectors and the output of the PRE level detector to check for a logic pattern of 10101101. This pattern, which is embedded in every track of servo code, indicates one of two conditions: either the beginning of a new sector has been detected (sector timing) or the beginning of physical sector zero has occurred (index mark). When this pattern is detected, this circuitry outputs a Sector Timing Pulse (STP-L) to the UPROC PCA, unless the pattern occurred within 163 microseconds of the previous pattern; in this case, an Index (IDX-L) pulse is output to the UPROC PCA. These two signals are used by the UPROC PCA during data transfer operations with the disc.

3-89. Phase-Locked Loop (PLL). The PLL, after locking itself to the output from the PRE level detector, synthesizes the Servo Clock (SCK) which is used by the read/write PCA during write operations. A second PLL clock output (1.45 MHz) is used to estab-

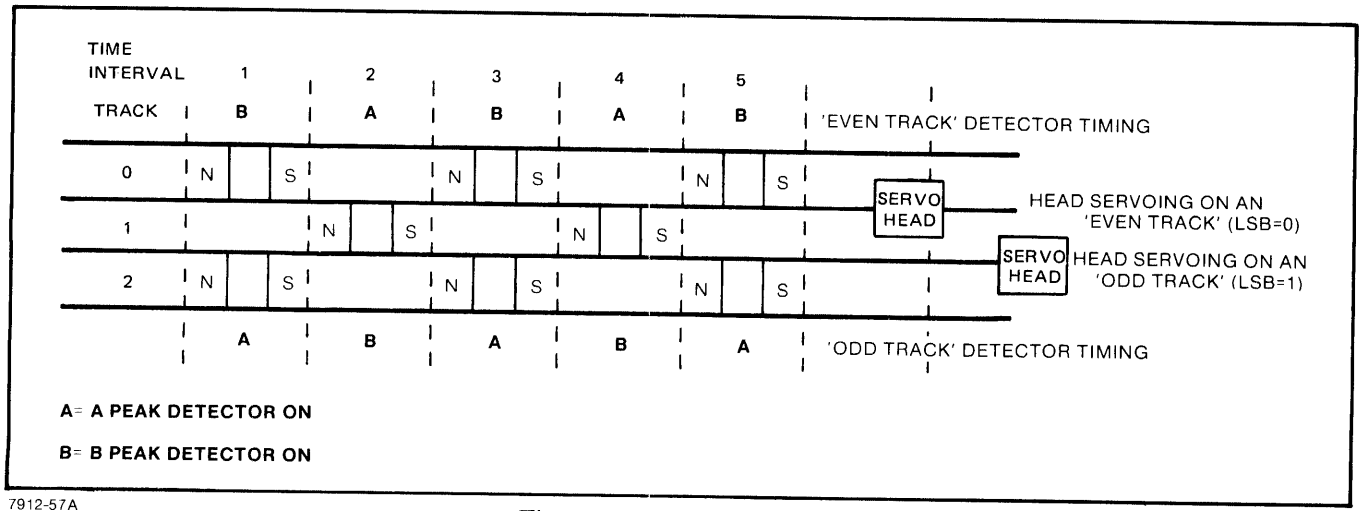

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Figure 3-9. Track Servoing

lish correct peak detector timing. The MODE input from the track follower latch controls the frequency of the internal PLL feedback clock, selecting either a 780 kHz or 1.56 MHz clock signal depending on the current drive operation.

3-90. Automatic Gain Control. The AGC circuit provides feedback to the servo filter/amplifier to control output signal gain. If the servo head is off the servo tracks, AGC gain is high. As the head moves over the servo tracks, AGC gain is lowered to the level required for a constant output signal. This circuit also contains a comparator that monitors the level of the AGC voltage; as long as the voltage remains within the comparator limits, the AGC-L status line will be asserted.

3-91. Position Error Amplifier. Head positioning is accomplished using the outputs from the A and B peak detectors. The position error amplifier subtracts the value of peak A from the value of peak B and outputs the result as the Position (POS) signal. When the value of POS is zero, the data heads are positioned at the center of a data track. If the heads are not on track, the nonzero POS signal will cause the actuator control circuitry to move the heads in the direction necessary to position them on track. A negative POS signal moves the heads toward the outside of the disc surface; a positive value moves the heads toward the inside of the disc.

The servo tracks are used to establish proper head position. The number of servo tracks (582) is identical for all drives; however, head positioning relative to these tracks differs between drives (see figure 3-10). The data heads on the HP 7911 and HP 7912 are on track when the servo head is centered over the boundary between two adjacent servo tracks. This servo technique supports a recording density of 582 data tracks per band. The HP 7914 data heads are on track when the servo head is offset one-quarter track either side of the boundary between two adjacent servo tracks. This servo technique supports the double-density recording scheme of 1,164 data tracks per band (two per servo track). The direction of head offset is controlled by the UPROC PCA via the A-circuit Gain (AGN) and B-circuit Gain (BGN) signals. These signals alter the gain of the position error amplifier to achieve the proper head positioning.

Two additional signals, Compensation 1 (COMP1) and Compensation 2 (COMP2), connect the gain circuitry of the position error amplifier to a resistor located on the flex PCA-A10. The value of this resistor is selected to compensate for differences in HP 7914 servo head gap width; this compensation ensures that the proper offset distance is achieved regardless of variations in head gap width. This resistor does not affect the amplifier on the HP 7911 and HP 7912.

To aid in marginal data recovery, the position error amplifier uses an analog output from the offset generator (OSV) to position the data heads slightly off track.

3-92. Track-Crossing Detector. This detector monitors the POS signal during seeks and outputs a Track-Crossing Pulse (TRX-L) each time the servo head crosses the boundary between two servo tracks. These pulses are used by the UPROC PCA to determine the location and velocity of the heads during a seek.

3-93. Track-Center Detector. During a seek, the On-Track (ONT-L) output from this detector is used by the UPROC PCA to determine when the heads are within one-quarter of a track of their final position. At that time, the microprocessor asserts the Fine Servo (FSR-H) and clocks it into the servo latch. This signal causes the heads to be locked on the desired track. When asserted, the FSR-H signal also increases the sensitivity of the track-center detector by altering its feedback: ONT-L is now asserted only when the heads are within a very small distance, or window, either side of track center. ONT-L is used by the read/write PCA to determine when disc access may begin.

3-94. Track Follower Latch. The UPROC PCA inputs data to this latch on the data bus (D0-H through D7-H). The input on D6-H is output to the peak detector as the Least Significant Bit (LSB-H) signal. LSB is set low or high at the beginning of a seek operation to establish the proper timing for the peak detectors. Data lines D0-H through D3-H provide 16 binary offset values to allow the servo head to be positioned slightly off-track in either direction. Offset is useful when attempting to recover marginal data during a read operation. The offset bits are output to the offset generator and are initiated by the Z80 CPU in a Set Retry Time command or by the CIC command parameter during an error rate test. Input lines D4-H and D5-H are offset direction bits. The MODE input (D7-H) to the track follower latch is output to the PLL to control its mode of operation.

3-95. Offset Generator. Offset values and the offset direction bits input from the track follower latch are changed to positive or negative analog voltages by this digital-to-analog (D/A) converter. This analog voltage (OSV) is used by the position error amplifier to achieve the desired head offset.

3-96. Servo Latch. The UPROC PCA controls head movement and positioning with signals input to this latch. The Direction (DIR-H) and Seek (SEK-H) signals control head movement during seeks. When track following, the Fine Servo (FSR-H) signal closes

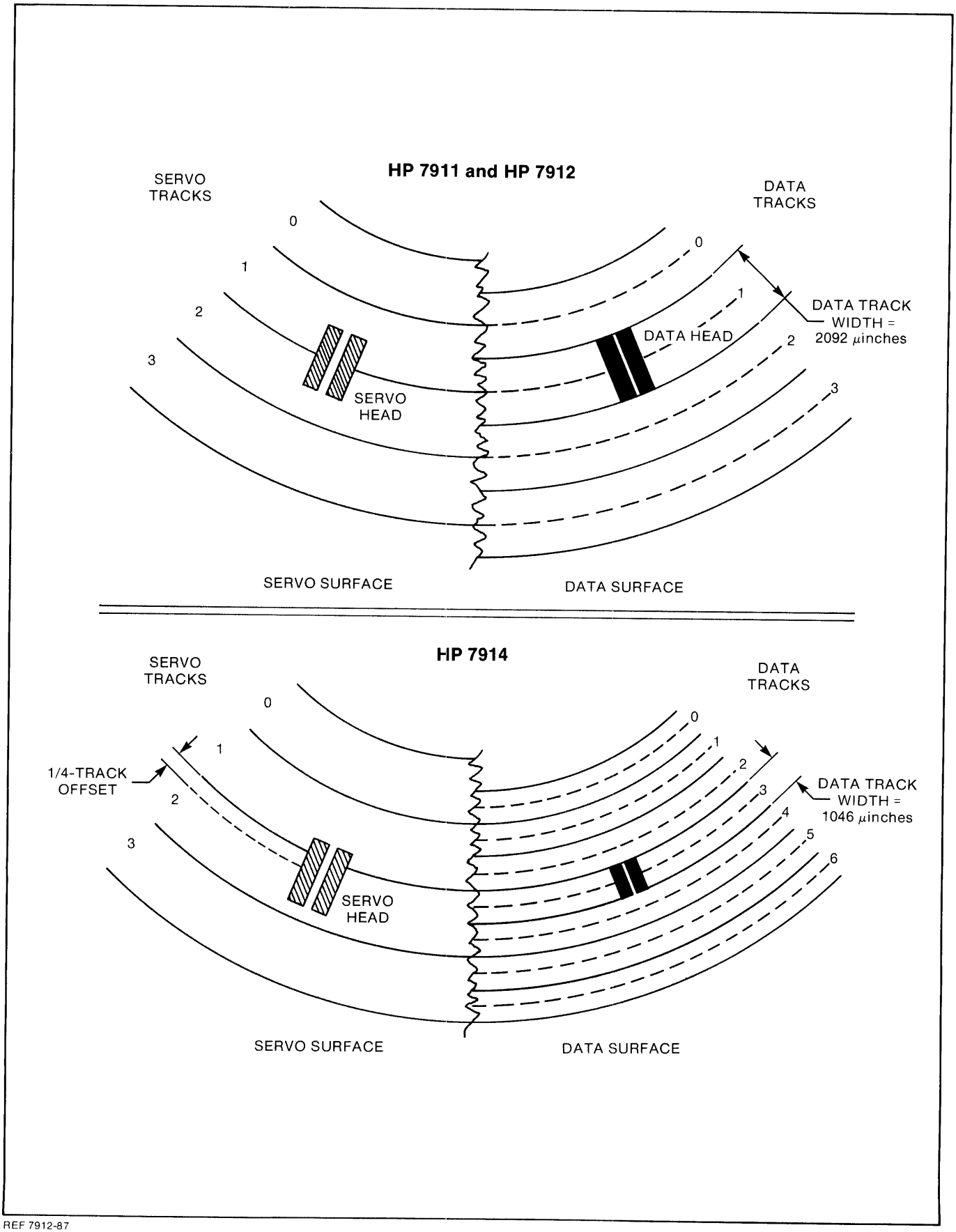

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Figure 3-10. Head Positioning

the head positioning servo loop causing the heads to be locked on track. Two signals, Compensation 1 (COMP1) and Compensation 2 (COMP2), control head positioning in the HP 7914. When asserted by the UPROC, the Load Heads (LHD-H) signal energizes the relay supplying current to the rotary actuator.

3-97. Reference Amplifier. This amplifier provides a single positive and a single negative reference voltage to the seek logic. These voltages control the magnitude and direction of actuator current during a seek. The positive reference voltage moves the heads toward the inside of the disc; the negative voltage moves the heads toward the outside of the disc.

3-98. Seek Logic. This switching circuitry selects one of three input voltages to be output to the actuator control circuit. During a seek (SEK-H asserted), one of the reference amplifier inputs will be selected. The state of the Direction (DIR-H) signal determines which reference voltage (positive or negative) will be output. During track following, the Fine Servo (FSR-H) signal is asserted; this selects the Position (POS) signal as the input to the actuator control circuit. The seek logic outputs a Seek (SEK-L) signal to the read/write PCA to inhibit read or write operations during a seek.

3-99. Actuator Control. This circuit is the current source for the rotary actuator. Inputs to this circuit include the following: a current control line from the Servo Latch (LHD-H); a reference voltage from the Seek Logic; and +20V and -20V supplies from power regulator PCA-A13. Two lines Actuator Current Source (ACS) and Actuator Current Return (ACR), provide the current path for the rotary actuator coil.

During a seek, the magnitude and direction of actuator current is controlled by one of the output voltages from the reference amplifier. This voltage causes constant acceleration of the heads across the disc. During track following operation, the POS signal is input to the actuator control circuitry to lock the heads on track.

3-100. Latch Select. Decoding of Servo Select (SERS-L), Read (RD-L), Write (WR-L), and Address Bus Bits 0 and 1 (A0-H and A1-H) establishes read or write modes on the servo PCA. In the write mode (WR-L enabled) this circuit selects either the track follower latch for track following operations, or the servo latch for seek operations. Read mode (RD-L enabled) allows the UPROC PCA to read status lines from the fault register.

3-101. Fault Register. The register inputs are status signals which originate throughout the drive: Speed Up Don't Care (SPUD), Speed OK (SOK-H), Write and Off Track (WOT-L), Off Track (OFT-L), Possible Power Fail (PPF-L), Destructive Write Fault (DWF-L), Identify (IDENT), and Automatic Gain Control (AGC-L). When the fault register is addressed, this data is output to the UPROC PCA-A3 on the data bus (D0-H through D7-H).

3-102. Master Reset Buffer. During power-on/power-off sequences the Master Reset (MRST-L) input from the power regulator PCA is buffered here and used to clear both the track follower latch and the servo latch, and to disable actuator current.

3-103. FLEX CIRCUIT PCA-A10. This assembly is located inside the sealed disc mechanism. Within the servo system, the primary function of the flex circuit PCA is to serve as a path between the servo PCA, the rotary actuator, and the servo head. These paths carry the actuator current, the servo preamplifier supply voltage, and servo code from the servo heads. Two signal lines, Compensation 1 (COMP1) and Compensation 2 (COMP2), compensate for HP 7914 servo head width.

3-104. TAPE SYSTEM

The tape system, (see service sheet 5, figure 4-22) in all units consists of the Tape Interface Board (TIB) PCA-A6, the Tape Mechanism, and Switch PCA-A15. In standard drives, the TIB PCA interfaces only with DMA PCA-A4 and UPROC PCA-A3 via jumper PCA-A7. In disc drives configured for dual controller option 001, the TIB PCA interfaces with TIB DMA PCA-A1 and TIB UPROC PCA-A2, and jumper PCA-A7 is removed. This isolates the tape system from the disc read/write system.

In the following discussion the operation of the standard drive will be detailed. The only differences for dual controller option 001 are that there is no path via the jumper PCA, and most signal mnemonics in the TIB DMA PCA and TIB UPROC PCA have the added mnemonic prefix "L" (Linked) to distinguish them from corresponding disc system signal mnemonics.

3-105. TAPE WRITE OPERATION. A write operation to the tape can be initiated in two ways: the CIC can initiate the operation, or the write can be initiated, locally using the SAVE switch. Once initiated, the TIB PCA, using target information provided by the UPROC, instructs the tape mechanism to locate the block on the tape where the write operation will begin. Once the target block is located, the DMA PCA begins outputting the serialized NRZ data stream to the TIB PCA.

Once on the TIB, the serialized data is converted to parallel form (deserialized) and stored (in RAM) until

1,024 bytes of data have been transferred. This temporary conversion of the data back to parallel form is necessary to support the ECC scheme used on the tape (refer to paragraph 3-133). When the DMA PCA has transferred 1,024 bytes of data to the TIB PCA, the data is serialized again and, with the TIB providing the necessary timing control, the serial data is converted to MFM format and sent to the tape mechanism where it is written on the tape.

3-106. TAPE READ OPERATION. A tape read operation can be initiated in two ways: the CIC can initiate the read, or the read can be initiated locally using the RESTORE switch. Once initiated, the TIB PCA, using target information provided by the UPROC, instructs the tape mechanism to locate the block on the tape where the read operation will begin. Once the target block is located, the data is read from the tape and passed in serial fashion from the tape mechanism to the TIB PCA.

Incoming serial data on the TIB PCA is converted from MFM format to NRZ data. The NRZ data stream is checked for errors and then converted into parallel data format. This parallel data is temporarily stored in RAM on the TIB and, if an error was detected by the CRC, the necessary data in RAM will be used to reconstruct the lost data (refer to paragraph 3-133). Once the data in RAM is determined to be valid, it is serialized and output to the DMA PCA. The DMA PCA checks the incoming data, converts it to parallel format, and outputs the data to the CIC or the disc, as appropriate.

3-107. MICROPROCESSOR PCA-A3 AND TIB MICROPROCESSOR PCA-A2. The microprocessor (UPROC) PCA tape control circuits consist of the following circuits: Z80 CPU, ROM, RAM, Hex Display, Decode Logic, CTC, Tape Counter, Multiplexer, and Control Logic.

3-108. Z80 Central Processing Unit (CPU). The Z80 CPU is the control center for tape system operation. Address, command, and control information from the Controller-In-Charge (CIC) is processed and used to output various control signals to the tape system. Internal address lines (A0-H through A3-H) are generated here to access memory locations on the TIB PCA.

3-109. Read-Only Memory (ROM). Programs stored in ROM translate the information received by the Z80 CPU into microcode instructions which the Z80 CPU can then use to control the tape mechanism.

3-110. Random Access Memory (RAM). Program variables are temporarily stored in this memory. When the Z80 CPU addresses the RAM via the address bus (A0-H through A11-H), information can be written to, or read from, the RAM on the data bus (D0-H through D7-H).

3-111. Hex Display. A seven-segment display provides a user interface to the self-test routines and diagnostics. Coded status of the drive is displayed here. For more information regarding self test and diagnostics, refer to Section IV, Service Information.

3-112. Decode Logic. Select signals used to access other boards are generated by decoding address bus inputs. These select signals can also enable appropriate circuitry on individual boards for a specific operation.

3-113. Counter-Timer Chip (CTC). The CTC contains four programmable counter/timers, each of which is capable of generating an interrupt to the Z80 CPU. During tape operations this circuit counts data blocks and clocks the gap between blocks. The CTC output (CTCO-H) to the TIB PCA is used for seek operations on the tape.

3-114. Tape Counter. Input signal CTC Trigger (CTCT-H) from the TIB PCA clocks this counter which keeps track of sectors on the tape. This counter is cascaded with the CTC.

3-115. Multiplexer. The multiplexer provides an interface to the Z80 CPU from the service switches used to initiate self-test or diagnostic routines. For more information on these routines, refer to Section IV, Service Information.

3-116. Control Logic. Control signals received from the Z80 CPU allow this circuit to generate the Read (RD-L) and Write (WR-L) signals. These two control signals set the tape system in the proper mode of operation.

3-117. DISC MEMORY ACCESS (DMA) PCA-A4 AND TIB DMA PCA-A1. The DMA PCA tape system circuits consist of the following circuits: PHI and PHI Latch, Byte Control, Data Counter, Processor Interface, Header RAM, Data RAM, SERDES, CRC, and the Disc/Tape Interface. The Error Correction Code (ECC) block is shown, but is not used in the tape system.

3-118. Processor to HP-IB Interface (PHI) and PHI Latch. Under Z80 CPU control, the PHI and PHI Latch transfer parallel bytes of information

across the Hewlett-Packard Interface Bus (HP-IB). Data is transferred from the HP-IB to the data RAM during write operations, and in the reverse direction for a read operation. The PHI acts as a buffer for all HP-IB signals in and out of the DMA PCA. The PHI Latch is a holding register for one byte accompanied by two control bits. The control bits are decoded to determine whether the byte is data, a secondary command, or the last data byte (during a read operation).

3-119. Byte Control. Two ROM-based state machines control all data byte movement in the DMA PCA. One state machine controls data transfers between the PHI, data RAM, and SERDES; the other state machine controls data transfers between the PHI and PHI latch. The byte control prevents incoming data from overrunning the data RAM. It accomplishes this during a read by holding the data transfer until one whole 256-byte block is read from the tape. During a write, data transfer is delayed until an entire 256-byte block is available in data RAM.

3-120. Data Counter. Three counters comprise the data counter: an input/output (I/O) address counter, an I/O byte counter, and a disc address counter. The I/O address counter addresses the data RAM during PHI and data RAM transfers. Before each data transfer between the drive and the host is begun, the UPROC loads the I/O byte counter with the number of bytes contained in the transfer. As the transfer progresses, the I/O byte counter counts each byte transferred over the HP-IB and, when the required number is reached, the UPROC is alerted to stop the transfer.

The disc address counter is a 13-bit counter used to address the header RAM and data RAM during data transfers between the DMA and the tape. During the transfer of each block, the lower nine bits of the counter are used to address the two RAM's in the following sequence: six bytes of header RAM (header), 256 bytes of data RAM (data field), and seven bytes of header RAM (postamble). The four most significant bits of the disc address counter determine which 256-byte block of data RAM will be addressed during the data transfer. These four bits allow the UPROC to alter the sequence of blocks transferred if a nonsequential order is required.

3-121. Processor Interface. Select and control lines from the microprocessor PCA are input to the DMA PCA via this block. Inputs include three select lines, two control lines, eight bidirectional data lines, and twelve address lines. The select lines are: DMA Select (DMAS-L) which allows the microprocessor access to the byte control; Buffer Select (BUFS-L) which allows the microprocessor access to the data RAM; and Input/Output Select (IOS-L) which allows the microprocessor access to the PHI. Read (RD-L) and Write (WR-L) control lines provide operational mode control. Data lines D0-H through D7-H provide additional control lines and status feedback lines. The address lines (A0-H through A11-H) are used to access various circuitry throughout the drive.

3-122. Header RAM. The six bytes of tape header information (see figure 3-11) are stored in the lower six bytes of this RAM. The upper seven bytes of the header RAM contain error correction data; during a tape write operation, this data is output to the TIB where it is discarded. Thte TIB generates the two bytes of CRC data appended to each block of data written on the tape.

3-123. Data RAM. All data to or from the disc, tape, or CIC must pass through this buffered storage. Up to 16 blocks, each containing 256 bytes, can be stored here at one time.

3-124. Serializer/Deserializer (SERDES). Two registers, one a holding register and one a shift register, change parallel bytes to serial bit data during a write operation and reverse the process for read operations.

3-125. Cyclic Redundancy Check (CRC). This circuit is both a checker and a generator for CRC information. During a write, the contents of the data RAM are clocked through the CRC block and 16 bits of CRC are appended at the end of each sector. During a read, the serial data is clocked through, checked, and if no errors are detected the CRC will be filled with all logic zeroes. If an error is detected, as indicated by any logical 1 bit, the CRC will flag the data as having a CRC error.

3-126. Disc/Tape Interface. This is the serial data interface to the TIB PCA. Five lines provide the data path and control for transfer of data. The DMA Input (DIN-H) and Output (DOUT-H) are the data lines between the DMA and TIB. Start of Sector (SOS-L) and Start of Data (SOD-L) when enabled, tell the DMA PCA to get ready to transfer and start data transfer, respectively. A timing pulse, Read/Write Clock (RWC-L), clocks data in and out of the disc/tape interface.

3-127. JUMPER (JMP) PCA-A7. Standard drives use this PCA as a jumper link between the controller (DMA PCA and UPROC PCA) and the tape circuitry. When a dedicated controller for the tape system is installed, this PCA is removed to isolate the disc controller from the tape controller. Signals on both sides of the jumper PCA are identical in function, but a prefix letter "L" (meaning Linked) is added on the

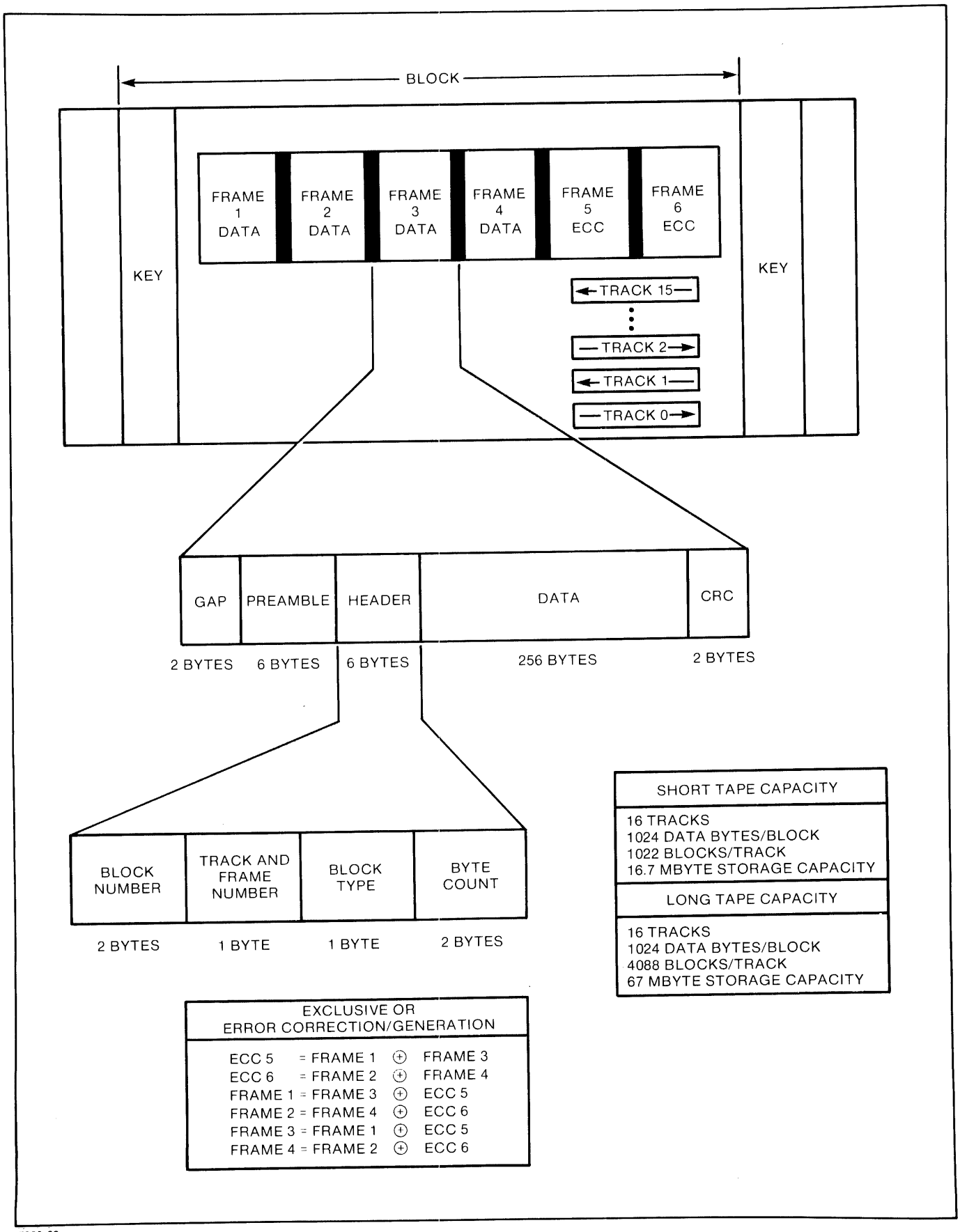

Figure 3-11. Tape Block Format

TIB PCA side to distinguish these tape signals from similar disc signals.

3-128. TAPE INTERFACE BOARD (TIB) PCA-A6. The TIB PCA consists of the following functional circuits: TIB Microprocessor Interface, TIB State Machine, TIB DMA Interface and SERDES, TIB RAM, TIB ECC, TIB CRC, TIB Formatter/Separator, and Clock Generator.

3-129. TIB Microprocessor Interface. The TIB microprocessor interface connects the TIB PCA to the UPROC PCA, the tape mechanism, and switch PCA-A15. Commands which control tape motion, tape head movement, and some TIB PCA functions are stored here. Tape system status is output to the UPROC PCA via data lines LD0-H through LD7-H. The tape mechanism auto-load sequence is initiated here.

A select line, TIB Select (TIBS-L), from the UPROC PCA is used to enable the data bus. Four address lines, LA0-H through LA3-H, select memory locations in this circuit. The LRD-L signal connects the status bus (ST00 through ST07) from the tape module to the data bus. The tape module command bus (CMD00 through CMD07) is connected to the data bus when the LWR-L signal is enabled.

Data sequencing to and from the tape module is controlled by four lines: Command Strobe (CSTROBE-H), Status Strobe (SSTROBE-H), Status Acknowledge (SACK-H), and Command Acknowledge (CACK-H). A signal line to the tape module controller, Read/Not Write Enable (RNWEN), selects the read or write mode in the tape module which controls the direction of the data transfer. Three switch inputs from switch PCA-A15 initiate tape system routines, and two outputs to this PCA illuminate light-emitting diodes (LED) which indicate tape mechanism status.

3-130. TIB State Machine. This circuit provides much of the control over the TIB PCA and its functions. The state machine can terminate a seek operation, it can interrupt a tape Verify command at a faulty block, it will override the Z80 CPU if operation becomes erratic, it controls data transfers between the TIB RAM and SERDES (on the TIB PCA), and it tests the TIB CRC flags to determine whether outgoing data needs correction to be recovered.

Incoming data must have CRC and ECC information (generated on the DMA PCA) removed before being transferred beyond the TIB DMA interface and SERDES block; the TIB state machine does this. In addition to all the functions performed above, this circuit generates the Linked Start of Sector (LSOS-L) and Linked Start of Data (LSOD-L) signals to the TIB DMA interface circuit, and the Linked CTC Trigger (LCTCT-H) signal to the UPROC PCA. The LCTCT-H pulses down-count the CTC to zero during seek or verify modes, and start a timer for tape write modes. The Linked CTC Output (LCTCO-H) signal input indicates a time-out on the CTC timer.

3-131. TIB DMA Interface and SERDES. Non-return-to-Zero (NRZ) serial data being transferred between the DMA PCA and the TIB RAM passes through this block. Input data arrives on the Linked DMA Output (LDOUT-H) line and is output on the Linked DMA Input (LDIN-H) line. Three other outputs to the DMA PCA provide timing for all data transfers; the Linked Read/Write Clock (LRWC-l) controls the actual transfer timing, and LSOS-L and LSOD-L generated by the TIB state machine trigger the beginning of the transfer operation.

The Serializer/Deserializer (SERDES) portion of this circuit converts the serial bit data from the DMA PCA (via LDOUT-H) or the tape (via RDATA) into parallel bits before loading the data into the TIB RAM. Parallel bits must also be converted back to serial bit data before being output to the DMA PCA (via LDIN-H) or the tape (via WRDATA).

During a write to tape, serial bit data from the DMA PCA is deserialized (converted to parallel bits) and loaded into the TIB RAM. Up to four frames can be loaded; a frame being equivalent to a sector on the disc. Once the RAM is full the parallel bits are shifted back out of the RAM, serialized again, and sent to the TIB CRC.

When reading from tape, the serial data from tape is deserialized and loaded into RAM. When the RAM is filled, the data is serialized and output to the DMA PCA.

3-132. TIB Random Access Memory (RAM). Two memory chips store parallel bytes of header and data between transfers to tape or DMA. Up to four frames maximum can be stored here at one time. When a read operation results in an error, the bad frame is over written in RAM through a reconstructed version of the frame. The reconstructed frame is explained in the following paragraph.

3-133. TIB Error Correction Code (ECC). The ECC circuit allows each frame to be reconstructed when an error is detected. When the four data frames stored in TIB RAM are output to tape, an additional two frames of ECC data with their own header information are generated by the TIB ECC. These frames are constructed by an exclusive-OR combination of data frames 1 and 3 to form ECC frame 5, and data frames 2 and 4 to form ECC frame 6. If an error is flagged in a data frame during a read operation, this frame can be reconstructed by exclusive-ORing the

corresponding data frame and ECC frame (for example, frame 1 and 5 can be used to reconstruct frame 3).

In the example, if both frame 1 and 5 are bad, frame 3 will be flagged as having an uncorrectable error. If both frame 1 and 3 are good, frame 5 is not needed for data recovery.

3-134. TIB Cyclic Redundancy Check (CRC). The TIB CRC appends two bytes at the end of each frame of data before the frame is written to the tape. On read-back, these two bytes are checked and the TIB state machine is flagged if an error is detected. If both corresponding data frames (1 and 3, or 2 and 4) are flagged as being erroneous, this indicates that an uncorrectable error exists and the data is not recoverable.

3-135. TIB Formatter/Separator. The Formatter portion of this circuitry changes the NRZ data on the WDATA line into Modified Frequency Modulated (MFM) data. This MFM data is characterized as having a level transition occur in the center of each "1" bit, and at the boundary of adjacent "0" bits (see figure 3-8). The MFM data is precompensated to offset the effects of bit shift in certain bit patterns, then the data is output to the tape on the Write Data (WRDATA) line.

The separator portion of this circuit receives the Read Data (RDDATA) input from the tape and decodes the MFM data into NRZ data. To compensate for tape speed variations, the separator is phase-locked to the incoming MFM data. The separator output is RDATA.

3-136. Clock Generator. This circuit generates a 19.2 MHz clock which is frequency divided to create other clocks used throughout the TIB PCA for data transfers and TIB State Machine timing.

3-137. TAPE MECHANISM. The tape mechanism has a microprocessor-based tape mechanism controller which controls the operation of the capstan motor and the head stepper motor. The tape mechanism also contains a signal processor which converts the tape head signal into an MFM encoded TTL signal.

3-138. Tape Mechanism Controller. The tape mechanism controller receives commands from the Z80 CPU over the Command Bus (CMD00 through CMD07) and sends back status over the Status Bus (ST00 through ST07). The tape mechanism controller adjusts the position of the Stepper Motor and the gain of the Signal Processor, and it provides control for the Capstan Motor.

3-139. Tape Cartridge. The tape cartridge is preformatted (see figure 3-10) with a full width recording device which writes keys across the one-quarter inch width of the tape. A key contains a unique number which identifies the location along the length of the tape. The 150-foot tape has a capacity of 16.7 megabytes of user data achieved by recording 1,022 blocks on each of 16 tracks; the 600-foot tape has a capacity of 67 megabytes of user data achieved by recording 4,088 blocks on each of 16 tracks. In either tape, each block contains 1,024 bytes of data, plus synchronization, header, and error correction information. The 16 separate tracks are obtained by utilizing a movable single track read/write head. Blocks are accessed in the forward direction for even tracks and in the reverse direction for odd tracks; this minimizes rewind time. Keys can be read in both directions. A mechanical "write protect" is built into the cartridge also.

Tape history information is stored on a use log. During the unload sequence, the use log is updated with two entries: auto-load count and total number of blocks accessed. The auto-load count is the number of times the cartridge has been inserted into the tape mechanism.

Once the tape cartridge is initialized, it has one out of every 512 blocks set aside as a spare. The actual sparing technique is established with the Initialize Media command (refer to table 2-1). A block may be skip spared or jump spared. Skip sparing involves changing the address of a bad block and utilizing the next available spare as determined by a look-up table. Skip sparing results in minimal latency but requires addresses to be altered. Jump sparing, however, replaces the bad block with the closest available spare according to seek time. Any future reference to the jump spared block generates a seek directly to the spare.

Before a tape cartridge can be used in host-initiated data operations, *it must be certified.* The certification routine, which is initiated by the host, takes approximately 17 minutes for a 150-foot tape and approximately 67 minutes for a 600-foot tape. Tapes are available that have already been certified; these tapes are ready for immediate use. Although not recommended, save and restore operations, which are initiated and performed locally by the drive, can be done using an uncertified tape cartridge.

3-140. Tape Head. The Tape Head writes or reads on any of the 16 available tracks on the tape cartridge. A stepper motor controlled by the tape mechanism controller drives the tape head up or down across the width of the tape.

3-141. Capstan Motor. The capstan is a small cylindrical drive wheel used to drive the tape cartridge. The capstan motor is driven in either direction by the tape mechanism controller so that data can be written back and forth across the tape.

3-142. Stepper Motor. The Stepper Motor, driven by the tape mechanism controller, drives the single track tape head up or down to allow accessing of data on 16 separate tracks.

3-143. Signal Processor. The signal processor circuit connects the proper line to the tape head during a data transfer. For a read, the RDDATA signal is connected; for a write, the WRDATA signal is connected. The Read/Not Write Enable line (RNWEN) comes from the microprocessor interface on the TIB PCA-A6. The signal processor can also provide gain for the RDDATA or WRDATA signal.

3-144. SWITCH PCA-A15. The switch PCA provides the outside interface for the tape system. Three switches and two indicator lights are located on the switch PCA; two of the switches, SAVE and RESTORE, offer an image backup capability when the host computer is not able to do this using the HP-IB channel. Image backup stores a virtual copy of the disc's contents to the tape cartridge. On drives equipped with the dual controller option (001), the Save and Restore switches are inoperative. System commands must be used to do backup on drives configured with this option.

Note: When used in the context of the following paragraphs, the term "unload" implies a *logical* operation that is performed by the drive. Once the tape has been unloaded, the Eject lever is used to *physically* remove the tape cartridge from the tape mechanism.

3-145. UNLOAD Switch. When the UNLOAD switch is pressed, the controller will request release from the host. Once release is granted, the controller updates the error logs near the front of the tape (if necessary), rewinds the tape to "End of Tape" (EOT), updates the Use log, and unloads the cartridge with an audible buzz. If pressed during an auto load, the switch will stop the auto load and perform an unload operation. If the UNLOAD switch (SW3-L) is pressed during a save or restore operation, the operation will temporarily stop and the BUSY light will begin to flicker. If the switch is then pressed a second time while the BUSY light is flickering, an unload will occur. If it is not pushed within 5 seconds, the save or restore operation will resume. Pushing the UNLOAD switch during any other active operation initiates a release request from the host before unloading the tape; this gives the host some control over when the unload will occur. The unload sequence can also be executed from the system via an Unload command.

3-146. SAVE Switch. A full volume (the entire disc) can be copied to the tape cartridge by using the SAVE switch (SW1-L) located on the front of the switch PCA. A save can be done only when the tape system BUSY light (LAMP1) is off. The save operation does not require any host intervention, therefore it can be performed while the drive is on or off line; however, when on line, the drive must request release from the host to perform a save. To initiate a full volume (image) backup of the disc, press the SAVE switch once; within 4 seconds the BUSY light should begin to flicker (eight times per second). While the light is flickering, press the SAVE switch again to begin the backup.

If a save is attempted while the drive is on line, the BUSY light may not flicker indicating that the host has not granted release and that the save operation will not be performed. If this occurs, the save operation should be retried by pressing the SAVE switch again.

The transfer will start from logical block 0 on the disc and tape, and proceed until the disc volume has been completely transferred, or end of volume occurs on the tape. After the last block is written to the tape, a file mark is written in the following block. When SAVE is successfully completed, the cartridge is unloaded. If, during the transfer, a data error is encountered on the disc, the best guess is sent to the tape, and the save operation continues to completion; however, the tape is not unloaded and the BUSY light flashes (once per second) indicating that a data error has occurred. Pushing the UNLOAD switch at this time unloads the cartridge and clears the fault conditions.

Any unreadable keys detected on the tape during a save operation are marked in the spare table and skipped; the operation continues to conclusion with no fault indicated, and the cartridge is unloaded. If a hardware fault occurs during the save, the BUSY light flashes (if possible) and the tape is stopped at its current position. The tape is unloaded but the logs at each end of the tape are not updated. After a hardware fault, the subsystem returns from release with the appropriate failure status.

Two tapes are required to perform a save operation on the HP 7914. When the first tape is full, the save operation stops, the tape is unloaded, and the BUSY light alternately flickers for one-half second and extinguishes for one-half second; this repetitive pattern prompts the user to remove the first tape and install the second one. When the second tape is installed, the save operation continues until the entire disc contents have been transferred. The address of the first disc sector copied to each tape is logged in the copy data table of that tape. This address is used by the HP 7914 when restoring data to the disc from the tapes.

If it is necessary to backup only a portion of the HP 7914, the save operation can be stopped after the first tape is full. This is accomplished by pressing the UNLOAD button which will cause the BUSY light to

flicker continuously for 5 seconds. If the UNLOAD switch is pressed again while the light is flickering, the save operation will be terminated. If the UNLOAD switch is not pressed a second time, the drive will resume the save and continue to wait for the second tape to be installed.

3-147. RESTORE Switch. The RESTORE switch, located on the front of the switch PCA, performs the same function as the SAVE switch but in reverse: the entire contents of the tape are copied to the disc. In all other aspects the operation of the RESTORE switch is identical to the operation of the SAVE switch.

When restoring an HP 7914, the order in which the two tapes are installed is unimportant. The beginning disc sector address stored in the tape's copy data table ensures that the disc is restored in the proper format.

Note: Tapes that contain the image backup of an HP 7911 or HP 7912 can be used to restore an HP 7914. The drive will transfer the entire contents of the tape to the disc beginning at disc address 0.

3-148. Eject Lever. This slide lever ejects the cartridge out of the tape mechanism. A mechanical interlock prevents its actuation unless the cartridge has unloaded as described in paragraph 3-145.

3-149. BUSY Indicator. The BUSY indicator, when lit, indicates that a tape operation is in progress. In addition, the BUSY light is used during save and restore operations to indicate the current state of the operation (refer to paragraph 3-146).

3-150. PROTECT Indicator. The PROTECT indicator indicates that the present cartridge installed in the tape mechanism is protected against a write operation (SAVE).

3-151. POWER SUPPLY SYSTEM

The power supply system, see service sheet 6 (figure 4-24), provides all the regulated and unregulated dc voltages needed by the drive, plus the ac power for the disc mechanism spindle motor. The power supply system is contained within the power box located at the rear of the drive. It consists of the unregulated supply and regulator PCA-A13. The following paragraphs explain the power supply system operation and its circuits.

3-152. POWER-ON SEQUENCE. When power switch S1 is set to the on (1) position, the disc mechanism spindle motor begins spinning to bring the discs up to speed and commence air flow through the drive. While this is occurring, the Master Reset (MRST-L) signal will be active for about the first 20 ms to preset the drive to a known state and allow the voltage regulators time to stabilize. During approximately the first three seconds, the tape head stepping motor will be stepping the heads up and down. This causes a "chatter" sound in the tape module.

Once the voltage regulators have stabilized and MRST-L is disabled, the disc system and tape system begin their internal self tests. These tests include:

- Microprocessor RAM test
- Checksum test
- In-depth CTC test
- DMA RAM check
- PHI check
- Servo system check
- Read/write test of all heads using the maintenance tracks
- Read sparing information from the maintenance tracks
- Tape tests (not necessarily performed in this order)
  - — TIB test
  - — Write/read test
  - — Isolate, then display errors (if any)
- Disc system seek and verify test

These tests require approximately 30 seconds to complete. If all tests are successfully completed, a *F.* will be displayed on the status readout(s). (Refer to the *HP 7911, HP 7912, and HP 7914 Disc/Tape Drive Operator Instructions,* part no. 07912-90901.) A display other than *F.* indicates that one or more of the above tests failed. Refer to Section IV, Service Information, for a full explanation of the display error messages.

3-153. POWER-OFF SEQUENCE. If power is removed from the drive or a power failure occurs, the PPF-L signal is enabled. If a write or read operation is in progress, this will allow the disc system sufficient time to finish the sector being transferred before all the logic circuits are disabled. As the actuator loses current, a tension spring will pull the heads into the landing zones before they come to rest on the disc surfaces. When the -20V supply drops below approximately -10 volts, the motor brake will engage and stop spindle rotation and airflow through the drive.

3-154. UNREGULATED SUPPLY. These circuits provide ac power for the disc mechanism spindle motor, power strapping capabilities, and unregulated dc voltage for the regulator PCA-A13. Primary power enters line filter FL1, which reduces conducted noise between both the disc drive and the power line. The

power switch S1 controls both the primary power input lines, one of which is fused by line fuse F1. The power input lines connect to terminal block TB1 which can be strapped for various voltage configurations that feed power transformer T1. When a frequency change is required (60 Hz/50 Hz), a motor pulley and drive belt change must be made.

The disc mechanism spindle motor is strapped to TB1 in such a manner that 120 Vac is maintained for all configurations. Two center-tapped secondary windings are full-wave rectified to provide +11.5V unregulated, +20V unregulated, and -20V unregulated. Capacitor C1 filters ac ripple on the +11.5V input to the regulator PCA, and capacitors C2 and C3 filter ac ripple on the +20V and -20V inputs to the regulator PCA, respectively.

3-155. REGULATED SUPPLY. The regulated dc voltage circuits are located on regulator PCA-A13. Besides voltage regulation, this PCA provides overvoltage protection, power failure detection, undervoltage detection, master reset circuitry, grounding, and thermal protection.

3-156. Voltage Regulators. Regulated voltages include three negative voltages (-4V, -5.2V, and -12V) and four positive voltages (+5V, +6V, and two +12V supplies). Two separate +12V supplies are necessary because of the difference in disc system and tape system voltage sequence requirements. The supply labelled +12V is used in the tape system, and the supply labelled +12VL (volts low power) is used in the disc system.

3-157. Overvoltage Protection. The positive and the negative regulated supplies are each protected by a crowbar circuit. If an overvoltage situation occurs in the positive regulated supply, the positive crowbar will open the +20V and +11.5V fuses. The negative crowbar will open the -20V fuse if an overvoltage occurs in the negative regulated supply.

3-158. Power Fail Detection. Each unregulated voltage supply is monitored by a comparator circuit to determine if the voltage drops below a given threshold. The Possible Power Fail (PPF-L) signal is enabled if the voltage drops below this threshold. The regulated supplies maintain regulation at least 400 μs after PPF-L is enabled. This allows the disc drive to finish writing a sector before power fails. The PPF-L signal is latched into a fault register on servo PCA-A9 and routed to microprocessor PCA-A3. Further read/write operations are inhibited to prevent data loss.

3-159. Undervoltage Detection and Master Reset. An undervoltage condition on any regulated supply will generate a Master Reset (MRST-L) signal. This signal resets the drive to a default state to prevent erroneous writing of data. The MRST-L signal is also active for about 20 ms at power-on to allow the voltage supplies time to settle and time for the drive to establish default conditions.

3-160. Grounding. The regulator PCA-A13 uses three separate grounds. The first is a main power ground, which connects the unregulated supply filter capacitors to the motherboard via cables W3 and W4. This ground is designated BGND. The ground line designated AGND eliminates errors in the regulated voltages caused by voltage drops in BGND across regulator PCA-A13, power cable W8 and motherboard PCA-A11. The final ground, designated GND, is the ground for the rest of the noncritical circuits on regulator PCA-A13.

3-161. Thermal Protection. The entire air flow through the drive is directed across the heat sink on regulator PCA-A13. In the event that air flow becomes insufficient to hold the temperature of the heat sink below 100°C, a thermal switch (S505) on the heat sink will disable the voltage regulators until the heat sink temperature drops below 70°C.

SERVICE INFORMATION

SECTION IV

4-1. INTRODUCTION

WARNING

These drives do not contain operator-serviceable parts. To prevent electrical shock refer all maintenance activities to service-trained personnel.

Note: The drives do not require regularly scheduled preventive maintenance; however, the card cage air filter (2, figure 6-3) should be checked during normal service calls and cleaned if necessary.

This section of the manual contains information for diagnosing problems and repairing the drives. Included are functional diagrams, wiring interconnect information, and troubleshooting procedures. Figure 4-1 shows the locations of the controls and indicators used to isolate malfunctions.

4-2. SERVICE TOOLS

TORX® hardware is used in the assembly of the drive. This hardware requires the use of special drivers (refer to table 4-1). In this manual, any reference to this type of hardware will be accompanied by the appropriate driver size (e.g., T15).

Special tools needed to service the drive are listed in table 4-1.

WARNING

All products which utilize tape head cleaner are shipped with a Material Safety Data Sheet (MSDS). Follow all applicable safety precautions when using the tape head cleaner.

4-3. FLOWCHARTS AND STATE DIAGRAM

In most cases, malfunctions can be isolated to a specific printed circuit assembly (PCA) or module by using the self-test and diagnostic switches (see figure 4-2). Instructions for isolating a failure are provided in the troubleshooting flowcharts, figures 4-5, 4-6, and 4-7. The state diagram, figure 4-8, is a representation of the self-test sequence. The symbols used in the flowcharts and the state diagram are described in figure 4-4. If a malfunction cannot be isolated to a particular item using this procedure, refer to the *CS/80 External Exerciser Reference Manual,* part number 5955-3462.

Table 4-1. Special Service Tools

ITEMS	HP PART NO.
Cleaning Swabs (package of 50)	9300-0767
Coupler	8710-1457
Tape Head Cleaning Solution (refill)	8500-1251
Torque Wrench	8710-1007
Variable Torque Driver	1535-2653
TORX® Driver Kit (includes the following items)	8710-1426
Bit, #T6	8710-1424
Bit, #T7	8710-1423
Bit, #T8	8710-1422
Bit, #T9	8710-1421
Bit, #T10	8710-1418
Bit, #T10, 3.5 in. long	8710-1465
Bit, #T15	8710-1415
Bit, #T20	8710-1416
Bit, #T25	8710-1417
Bit, #T27	8710-1420
Bit, #T30	8710-1419
Extension	8710-1425
Driver Handle	8710-1413
Pouch	8710-1412

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4-4. SYSTEM FUNCTIONAL DIAGRAMS

Figures 4-9 through 4-27 are the functional block diagrams and printed-circuit assembly (PCA) layouts for the drives. Each functional block diagram is labelled with a bold number. This number is used to direct the user from diagram to diagram. These diagrams include the overall block diagrams (service sheets 1 and 2), read/write system (service sheet 3), servo system (service sheet 4), tape system (service sheet 5), power supply system (service sheet 6), and wiring interconnection (service sheet 7). Each of the systems is discussed in detail in Section III, Functional Operation.

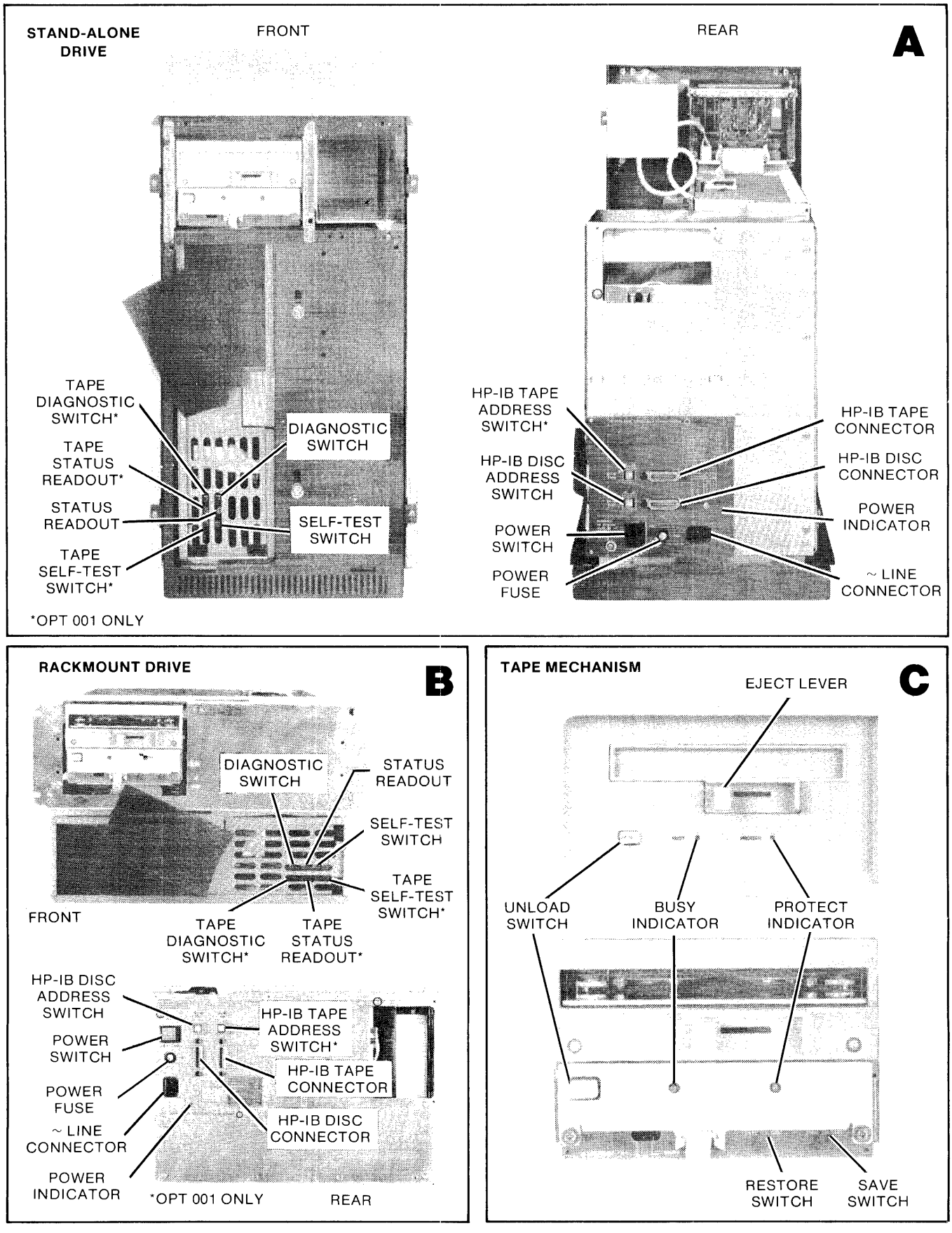
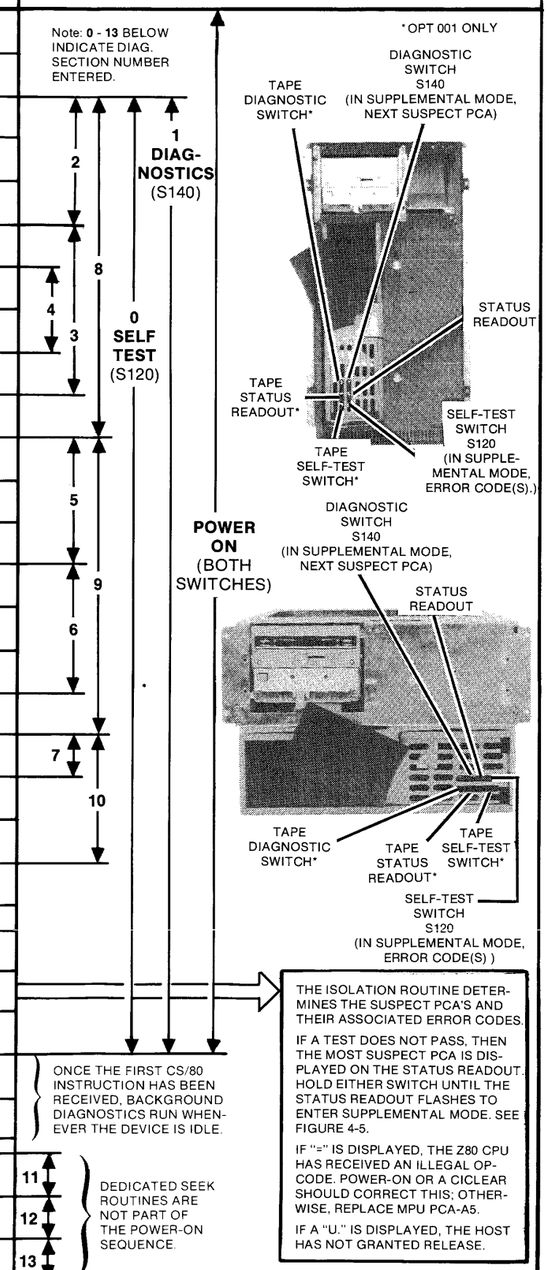


Figure 4-1. Controls and Indicators

TIME (APPROX)	STATUS READOUT	OPERATION PERFORMED	COMMENTS
4 s	8.	DESTRUCTIVE MPU RAM TEST	THE MPU RAM IS CLEARED, THEN SPECIFIC PATTERNS ARE MARCHED THROUGH THE RAM. AN ADDRESS CHECK IS PERFORMED ALSO. THE "8" IS DISPLAYED, THEN EACH SEGMENT LIGHTS SEPARATELY TO ENSURE LED OPERATION.
7 ms	0	INITIALIZE SOFTWARE TABLES	THE CPU REGISTERS ARE CLEARED, AND THE STATE VARIABLES IN MPU RAM ARE SET TO THE PROPER VALUES FOR RUNNING THE POWER-ON DIAGNOSTICS.
0.1 s	5	TEST MPU RAM	THIS NON-VOLATILE TEST INVOLVES DOUBLE-COMPLEMENTING EACH ADDRESS IN MPU RAM AND CHECKING THE RESULTS IN 4-BYTE SEGMENTS THROUGH THE ENTIRE RAM.
0.5 s	6	MPU ROM CHECKSUM	A CHECKSUM VALUE IS OBTAINED FROM EACH 4-KBYTE SEGMENT OF MPU ROM AND CHECKED WITH A PREVIOUSLY WRITTEN VALUE.
4 ms	3	MPU CTC TEST	EACH OF THE 4 COUNTERS WITHIN THE CTC IS CHECKED FOR COUNTING ACCURACY AND MICROPROCESSOR INTERRUPT CAPABILITY. THEN THE CTC IS INITIALIZED.
0.2 s	7	TEST DMA RAM	FIRST THE DMA RAM IS CLEARED, THEN SPECIFIC PATTERNS ARE MARCHED THROUGH THE DMA RAM. AN ADDRESS CHECK IS PERFORMED ALSO.
3 s	11	TEST DMA PCA	COMPLETE MPU-TO-DMA INTERFACE TEST INCLUDING DMA DATA RAM AND HEADER RAM, AND A DMA DATA TRANSFER TEST TO THE SERDES AND CRC AND BACK AGAIN.
25 ms	13	ECC TEST	ERROR CORRECTION CHIP (ECC) IS CHECKED USING A KNOWN ERROR PATTERN.
10 ms	4	PHI TEST	THE DATA PATH BETWEEN THE HP-IB AND THE DMA DATA RAM INCLUDING THE MPU-PHI INTERFACE IS CHECKED IN BOTH DIRECTIONS.
SEE COMMENT	2	SPINUP DELAY	THE POWER-ON TEST REQUIRES A 2 SECOND DELAY FOR THE SPINDLE TO REACH 3600 RPM: ALL OTHER DIAGNOSTICS TAKE 35 ms.
0.5 s	C	TEST SERVO PCA	THE SERVO CIRCUITRY INVOLVED WITH SEEKS IS TESTED AND CHECKED FOR CORRECT OPERATION.
90 ms	21	DYNAMIC SERVO TEST	ADJUSTMENT TABLES FOR FUTURE SEEKS ARE DERIVED AND A DYNAMIC SEEK TEST IS PERFORMED.
2 ms	A	SERVO - READ/WRITE INTERFACE TEST	THE INTERFACE BETWEEN THE SERVO AND READ/WRITE PCA'S IS CHECKED.
1 ms	E	READ FAULT LATCH	THE FAULT LATCH (ON THE SERVO PCA) GATHERS VITAL STATUS INFORMATION SUCH AS POWER FAIL, ON/OFF TRACK, AND OUT OF LOCK SIGNALS.
85 ms	F	READ/WRITE - DMA INTERFACE TEST	THE INTERFACE BETWEEN THE READ/WRITE AND DMA PCA'S IS CHECKED.
2 s	b	ACCESS MAINTENANCE TRACKS	THE CONTENTS OF THE MAINTENANCE TRACKS IS TRANSFERRED TO MPU RAM FOR QUICK FUTURE ACCESS. THIS IS THE FIRST DATA TRANSFER OPERATION INVOLVING THE DISC.
SEE COMMENT	9	READ SPARE TABLE	DURING A POWER-ON TEST, THE CONTENTS OF THE SPARE TABLE AND THE CURRENT INTERLEAVE VALUE ARE LOADED INTO MPU RAM (5 ms); ALL OTHER DIAGNOSTICS TAKE 0.5 ms.
1 s	d	TIB - DMA LOOPBACK TEST	DATA PATTERNS ARE LOOPED BETWEEN THE DMA AND TIB PCA'S AND CHECKED TO ENSURE PROPER OPERATION
SEE COMMENT	L	TAPE AUTOLOAD	IF A TAPE IS PRESENT, THE TAPE IS POSITIONED TO LOGICAL BLOCK ZERO (150 FOOT — 70 s; 600 FOOT — 180 s). IF NO TAPE IS PRESENT OR AUTO LOAD HAS ALREADY BEEN COMPLETED, 0.5 ms.
SEE COMMENT	H	TAPE PATTERN TEST	DATA IS WRITTEN TO A SPECIFIC TEST AREA ON THE TAPE, THEN READ BACK AND CHECKED FOR ACCURACY (4 s). TEST IS NOT PERFORMED FOR POWER-ON OR IF NO TAPE IS INSTALLED (0.5 ms). ALSO, THE TAPE MANUFACTURER'S BLOCK IS READ.
0.5 ms	t	TEST TAPE COUNTER	ALL 4 BITS ARE FIRST CLEARED TO ZERO, THEN SET TO ONE, AND CHECKED.
1 s	1	SEEK AND VERIFY TEST	FOR SELF TEST OR POWER-ON, A SEEK AND VERIFY TEST IS PERFORMED ON THE DISC UNIT (1 s).
SEE COMMENT		ERROR RATE TEST	FOR DIAGNOSTICS, AN EXTENSIVE ERROR RATE TEST (THE ENTIRE VOLUME) IS PERFORMED ON THE DISC UNIT (TIME GIVEN FOR INTERLEAVE = 0); 7911 - 70 s; 7912 - 140 s; 7914 - 280 s.
0.5 s	OFF	FINISH ISOLATION ROUTINE	ISOLATION ROUTINE WEIGHS ANY ERRORS AND DETERMINES SUSPECT CONDITIONS AND ASSOCIATED ERROR CODES. INFORMATION IS AVAILABLE IN THE REQUEST STATUS PARAMETER FIELD OR VIA THE MPU SWITCHES.
UNTIL CS/80 INSTRUCTION RECEIVED	P.	TEST RUN HAS PASSED	"P." IS DISPLAYED WHEN THE TEST WHICH WAS RUN HAS PASSED. THE PERIOD INDICATES COMPLETION OF A TEST; ANYTHING OTHER THAN "P" WITH A PERIOD INDICATES A SUSPECT CONDITION.
0.5 s	OFF	RUN BACKGROUND DIAGNOSTICS (SEE HIGHLIGHTED AREAS ABOVE)	THE STATUS READOUT IS BLANKED AS PART OF THE BACKGROUND DIAGNOSTICS SO THAT SUCCESSFUL COMPLETION CAUSES IT TO FLASH AT TWO-SECOND INTERVALS.
1.5 s	P.	BACKGROUND DIAGNOSTICS SUCCESSFUL **(FLASHING)**	BACKGROUND DIAGNOSTICS ENSURE DEVICE INTEGRITY DURING IDLE TIME. WHEN HOST RESUMES COMMUNICATION WITH DEVICE, BACKGROUND DIAGNOSTICS ARE DISABLED.
5.5 s	10	256 RANDOM SEEKS	THE DISC READS AND VERIFIES 256 DIFFERENT RANDOM ADDRESS LOCATIONS.
20 s	11	256 FULL STROKE SEEKS	THE DISC SEEKS FROM MINIMUM PHYSICAL CYLINDER TO MAXIMUM PHYSICAL CYLINDER AND BACK AGAIN (512 SEEKS TOTAL).
SEE COMMENT	12	FULL LOGICAL VOLUME INCREMENTAL SEEKS	ALL LOGICAL CYLINDERS ARE ACCESSED AND VERIFIED: 7911 - 6 s; 7912 - 12 s; 7914 - 24 s.

THESE TESTS ARE EXECUTED DURING BACKGROUND DIAGNOSTICS.



791X-1

Figure 4-2. Micro and Macro Diagnostics

4-5. CABLING INFORMATION

Tables 4-9 through 4-20 provide pin-to-pin cable wiring information. Figure 4-27 (service sheet 7) shows assembly interconnection using these cables. Table 4-21 lists the motherboard PCA (backplane) connections and signal mnemonics definitions, and table 4-22 lists power and grounding distribution throughout the drive.

4-6. DIAGNOSTICS

Resident within the drive is a vast set of diagnostics used to detect and isolate malfunctions. Internal diagnostics are run at power-on, while the drive is idle, and when either the self-test or diagnostic switch is pressed (see figure 4-2). In addition, the CS/80 external exerciser can be used to initiate diagnostic routines.

4-7. INTERNAL DIAGNOSTICS

The drive is capable of locally executing three troubleshooting routines which have been programmed into the microprocessor ROM. All routines execute thorough hardware checks. The power-on routine performs a full reset, delays certain tests until the spindle is up to speed, and tests all PCA's. The self-test routine performs the same tests as the power-on routine except that the microprocessor PCA is not reset and no delays are induced. The diagnostic routine runs the self-test routine, adds an error rate test, and forces an autoload of the tape.

The drive has two switches and a seven-segment hexadecimal display located on the edge of the microprocessor (UPROC) PCA (see figure 4-1). When first powered on, the device enters the normal mode. In normal mode, momentarily pressing the self-test switch will run self test, and momentarily pressing the diagnostics switch will run diagnostics. Self test takes about 30 seconds; diagnostics take about 2 to 3 minutes (with tape installed). Pressing both switches momentarily will cause a power-on to occur and is equivalent to turning the drive power switch to "0" and then to "1" again.

The period displayed on the status readout indicates that the device has finished execution of a test or has processed an input from one of the switches. When in normal mode, holding either switch depressed until the display flashes causes the drive to enter supplemental mode. Supplemental mode should only be used for troubleshooting. Once in supplemental mode, a number or the letter "P." appears on the display. The "P." means that the drive passed all tests which were run. If a number appears, this indicates a suspect condition (see figure 4-8). Press the self-test switch momentarily to see a two-digit error code (displayed one digit at a time) associated with the suspect condition which was displayed. The two digits represent a test error (TERROR) code as shown in table 4-7. Pressing the diagnostics switch momentarily will show the next suspect condition, if any. Any time "-." appears on the display, the last suspect condition or last error code has been displayed.

At any time, either switch can be held until the display flashes, and the results of the test which was run can be displayed again. To exit supplemental mode and return to normal mode, press both switches momentarily.

4-8. EXTERNAL EXERCISER

The CS/80 External Exerciser is a diagnostic interpreter which links the vast set of internal diagnostics and utilities within the drive to a service-trained person. The *CS/80 External Exerciser Reference Manual,* part number 5955-3462, illustrates in detail how the exerciser interfaces to any CS/80 device; included here is specific information for the drive. Table 4-2 is a list of all external exerciser commands which are recognized by the drive.

Table 4-8 lists the drive error (DERROR) codes which can be passed to the external exerciser during run-time operations or upon request, using the external exerciser commands. Paragraphs 4-9 through 4-34 define each external exerciser command (shown within parenthesis) with a description of any special attributes for that particular command.

4-9. CANCEL TRANSACTION SEQUENCE (CANCEL). This command cancels the CS/80 transaction sequence.

4-10. CERTIFY TAPE CARTRIDGE (CERT). This utility performs a complete write-then-read verification of the tape.

4-11. CHANNEL TEST UTILITY (CHANNEL). This utility checks the HP-IB channel interface to the drive.

4-12. CHANNEL INDEPENDENT CLEAR (CICLEAR). This command causes the drive to be cleared.

4-13. CLEAR LOGS UTILITY (CLEAR LOGS). This utility initializes the Run log, the error rate test (ERT) log, and the Fault log. Initialization clears any previously accumulated error information in the logs.

4-14. INTERNAL DIAGNOSTIC TEST (DIAG). This test initiates any of the internal micro- or macro-diagnostics within the drive. In order to initiate a diagnostic, the unit addressed must be the controller (address 15) and all other units must be idle. Due to

Table 4-2. External Exerciser Commands

COMMAND*	OPERATION PERFORMED	COMMAND*	OPERATION PERFORMED
CANCEL	CANCEL TRANSACTION SEQUENCE	REQSTAT	REQUEST STATUS
CERT	CERTIFY TAPE CARTRIDGE	REV	READ REVISION NUMBER UTILITY
CHANNEL	CHANNEL TEST UTILITY	RF SECTOR	READ FULL SECTOR
CICLEAR	CHANNEL INDEPENDENT CLEAR	RO ERT	READ ONLY ERROR RATE TEST
CLEAR LOGS	CLEAR LOGS UTILITY	RUN LOG	READ RUN LOG UTILITY
DIAG	INTERNAL DIAGNOSTIC TEST	SDCLEAR	SELECTED DEVICE CLEAR
ERRSUM	READ ERROR SUMMARY UTILITY	SPARE	SPARE BLOCK UTILITY
ERT LOG	READ ERROR RATE LOG UTILITY	TABLES	READ DRIVE TABLES UTILITY
EXIT	EXIT EXTERNAL EXERCISER	UNIT	SET UNIT NUMBER UTILITY
FAULT LOG	READ FAULT LOG UTILITY	UNLOAD	UNLOAD TAPE
HELP	DISPLAY HELP INFORMATION	USE LOG	READ TAPE USE LOG
INIT MEDIA	INITIALIZE SELECTED MEDIA	WRITE FM	WRITE FILE MARK ON TAPE
OPER	ENTER CS/80 OPERATIONS ROUTINE	WTR ERT	WRITE-THEN-READ ERROR RATE TEST
PRESET	PRESET DRIVE UTILITY		

* Some commands must be followed by an address; valid logical addresses in the drive are as follows:

HEAD	0-2 (HP 7911) 0-6 (HP 7912/HP 7914)	CYLINDER	0-571 (HP 7911/HP 7912) 0-1151 (HP 7914)
SECTOR	0-63		

the nature of some of the diagnostic tests, it is recommended that the unit address is set before running each diagnostic. Set the unit number to 0 (zero) after completion of the diagnostic. Figure 4-2 shows which internal tests are run for each valid diagnostic response (0-13).

4-15. READ ERROR SUMMARY UTILITY (ERRSUM). This utility initiates a printout of the error bit map. The error bit map is a history of all test errors (TERRORS) which have occurred since the last power-on or self-test sequence (refer to table 4-5).

4-16. READ ERROR RATE LOG UTILITY (ERT LOG). This utility allows access to the error rate log which contains all errors that have occurred when an error rate test was run.

4-17. EXIT EXTERNAL EXERCISER (EXIT). This command causes the CS/80 external exerciser program to exit.

4-18. READ FAULT LOG UTILITY (FAULT LOG). This utility permits access to the fault log which contains an accumulation of any drive faults (DERRORS and TERRORS) which have occurred since the log was last cleared (refer to table 4-8). If the drive has a dedicated tape system controller (option 001), no tape faults will be recorded in the fault log.

4-19. DISPLAY HELP INFORMATION (HELP). HELP lists the utilities and diagnostics available in the CS/80 external exerciser.

4-20. INITIALIZE SELECTED MEDIA (INIT MEDIA). This utility is used to format the media (disc or tape). For the disc, this utility erases all current data, and allows spares to be retained or not retained. For the tape, this utility will initialize the tape media.

4-21. ENTER CS/80 OPERATOR DESIGN ROUTINE (OPER). The OPER program routine allows certain CS/80 operations to be performed by the drive.

4-22. PRESET DRIVE UTILITY (PRESET). This utility forces all periodic upkeep tasks to be performed. This ensures that all logged information is up to date prior to reading all logs.

4-23. REQUEST STATUS (REQSTAT). This command causes the drive to return a status report which indicates the status for all transactions since the last request status or clear command.

4-24. READ REVISION NUMBER UTILITY (REV). This utility reads the revision numbers of the firmware installed within the drive. The external exerciser will display part numbers and their current revision numbers.

4-24A. READ FULL SECTOR (RF SECTOR). This command reads and prints out a full sector from the specified logical address. A full sector includes the sector header, user data, CRC, and ECC information.

4-25. READ ONLY ERROR RATE TEST (RO ERT). This test allows a sequential or random read to take place in order to locate any read errors.

4-26. READ RUN LOG UTILITY (RUN LOG). This utility allows access to the run log which contains an accumulation of data errors which the device has logged during run time.

4-27. SELECTED DEVICE CLEAR (SDCLEAR). This command allows any particular device on the HP-IB to be cleared.

4-28. SPARE BLOCK UTILITY (SPARE). This utility allows sparing of blocks (sectors) with the option of retaining or not retaining data from the spared block. Since each track on the disc has one available spare sector, trying to spare more than one sector on the same track causes the entire track to be spared.

4-29. READ DRIVE TABLES UTILITY (TABLES). This utility returns values stored in special tables within the drive. A list of the tables is as follows:

Table	Description
1	Disc Spare Track Table
M	Manufacturer's Tape Block Table
S	Tape Spare Block Table
C	Copy Data Table

The disc spare track table lists the logical tracks which have been spared for each head, and the sequential spare (scalar) which was used to replace the defective track. The manufacturer's tape block table identifies the origin and size of the tape cartridge. The tape spare block table contains the physical addresses of tape blocks which are spared. The copy data table contains the address of the first disc sector transferred to the tape during a copy data operation on the HP 7914. This address is used when restoring the disc contents from the tapes.

4-30. SET UNIT NUMBER UTILITY (UNIT). This utility specifies the unit to be addressed within the drive. The disc is unit "0"; the tape is unit "1".

4-31. UNLOAD TAPE (UNLOAD). This command allows the external exerciser to unload the tape cartridge in the same manner as pressing the UNLOAD switch on the front panel.

4-32. READ TAPE USE LOG (USE LOG). This command accesses the tape's use log.

4-33. WRITE FILE MARK ON TAPE (WRITE FM). This command writes a file mark at the current tape position.

4-34. WRITE-THEN-READ ERROR RATE TEST (WTR ERT). This test writes a predefined data pattern over a specified area of the disc, then reads all data which was written. The test attempts to locate any errors.

4-35. POWER DISTRIBUTION

The troubleshooting procedures in this section assume all power sources in the drive are within tolerance. Each power supply circuit is protected by a crowbar over-voltage circuit and an over-temperature shutdown circuit. The Power Supply System functional diagram, figure 4-24, and the Wiring Interconnect Diagram, figure 4-27, can be used to isolate power source malfunctions. To check the voltages, proceed as follows.

WARNING

The following procedure is performed with power supplied to the drive, and protective covers removed. This troubleshooting should be performed only by service-trained personnel who are aware of the hazards involved (for example, fire and electrical shock).

4-36. STAND-ALONE DRIVES

a. With power on, check the power indicator (see figure 4-1) to ensure that it is illuminated. If not, proceed to the following steps.

b. Disconnect the ac power cord from the drive.

c. Remove the following items:
   (1) Lower front panel (refer to paragraph 5-4).
   (2) Upper front panel (refer to paragraph 5-5).
   (3) Flip-top assembly (refer to paragraph 5-8).

d. Loosen the two screws which secure the power box cover and swing the hinged cover open.

WARNING

With ac power applied, hazardous voltages are present within the power box.

e. Connect the ac power cord.

f. Set the rear panel power switch to 1 (on).

g. Check the following voltages on the power regulator PCA (located on the hinged door):

Voltage	Voltage Range*	Ripple Voltage
+11.5V unregulated†	9 Vdc to 15 Vdc	2V p-p
+20V unregulated†	20 Vdc to 30 Vdc	1.5V p-p
-20V unregulated†	-20 Vdc to -30 Vdc	1.5V p-p
-4V regulated	-3.8 Vdc to -4.2 Vdc	N/A
-5.2V regulated	-4.94 Vdc to -5.46 Vdc	N/A
-12V regulated	-11.4 Vdc to -12.6 Vdc	N/A
+5V regulated	4.75 Vdc to 5.25 Vdc	N/A
+6V regulated	5.7 Vdc to 6.3 Vdc	N/A
+12V regulated	11.4 Vdc to 12.6 Vdc	N/A
+12 VL regulated	11.4 Vdc to 12.6 Vdc	N/A

*Voltage range includes minimum and maximum loads for all options.

†Voltage measured from BGND to load side of fuse clips for the specified secondary voltage.

4-37. RACKMOUNT DRIVES

a. With power on, check the power indicator (see figure 4-1) to ensure that it is illuminated. If not, proceed to the following steps.

b. Disconnect the ac power cord from the drive.

c. Loosen the two screws which secure the power box cover and swing the hinged cover open.

WARNING

With ac power applied, hazardous voltages are present within the power box.

d. Connect the ac power cord.

e. Set the rear panel power switch to on (1).

f. Check the voltages on the power regulator PCA (located on the hinged door). Refer to paragraph 4-36, step g, for the correct voltage values.

4-38. SPINDLE DRIVE TEST AND TROUBLESHOOTING

Spindle drive failures should be isolated to the component or subassembly level (see figure 4-6). To determine the cause of the failure, proceed as follows:

WARNING

Hazardous voltages are present inside the power box during this procedure.

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the drive belt cover (refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives).

d. Connect the ac power cord to the receptacle on the rear panel and to ac mains power.

e. Check the motor brake for proper operation as follows:

(1) While watching the motor pulley, set the POWER switch on the rear panel (see figure 4-1) to the 1 (on) position for one second, then return the switch to the 0 (off) position.

(2) The brake should disengage allowing the motor to spin up to speed. The motor should continue to spin freely for about three seconds after which the brake will engage causing rapid deceleration of motor pulley rotation. The brake will engage with an audible sound when the -20V unregulated supply drops below -15V.

(3) If the brake is working properly, proceed to step f, otherwise, check power supply operation (paragraph 4-35) and the brake cable. If these check good, the brake is defective and must be replaced (refer to paragraph 5-19).

f. If the spindle drive malfunction involves a motor that runs but will not come up to or maintain the proper operating speed, proceed to step h. If the motor fails to spin up, the motor control relay circuit may be defective. To check the operation of this circuit, proceed as follows:

(1) Gain access to the power supply box. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

(2) Disconnect the yellow wire from pin 4 of the relay in the motor control assembly (37, figure 6-4).

(3) Connect an ammeter in series with the yellow wire and relay pin 4.

(4) Set the POWER switch to 1 (on). Relay current should rise to about 3.5 mA and remain at that level until the spindle reaches 3,000 rpm (approximately 8 seconds). The current should then drop to zero.

(5) Set the POWER switch to 0 (off).

(6) If the relay current is satisfactory, reconnect the yellow wire to the relay and proceed to step g, otherwise, disconnect the red wire from pin 3 of the relay.

(7) Connect a DC voltmeter across the red (+) and yellow (-) wires.

(8) Set the POWER switch to 1 (on). The voltage should be +5V.

(9) Set the POWER switch to 0 (off).

(10) If +5V was measured in substep 8, the motor control assembly is defective and must be replaced (refer to paragraph 5-34). If the correct voltage was not measured, check the relay cable, the motherboard, and the microprocessor board. Replace any defective components.

g. To check the resistance of the motor windings, proceed as follows:

(1) Disconnect the motor power cable (W13J1) from the outside of the power supply box.

(2) Connect an ohmmeter across pin 1 (yellow) and pin 2 (blue) of the motor power cable connector. The resistance should measure 6.1 ohms to 7.5 ohms.

(3) Move one ohmmeter connection from pin 2 to pin 3 (red). The resistance should measure 10.2 ohms to 12.5 ohms.

(4) If either resistance measurement indicates an open motor winding, the motor must be replaced. (Refer to paragraph 5-23.)

(5) If the motor winding resistance is correct, the malfunction is most likely caused by a defective motor control assembly. Refer to paragraph 5-34 for removal and replacement instructions.

h. A motor that will not run at the proper operating speed may be the result of a shorted motor control relay. To check the relay, proceed as follows:

(1) Remove the cover on the motor control assembly (37, figure 6-4). Two screws hold the cover in place.

(2) Disconnect the wires on pin 1 (yellow) and pin 2 (blue) of the relay in the motor control assembly.

(3) Using an ohmmeter, measure the resistance across pins 1 and 2; reverse the leads and measure the resistance again. The resistance should be greater than 5 megohms in both directions. If the resistance is less, change the motor control assembly (refer to paragraph 5-34).

(4) Reconnect the wires to the relay.

(5) If the relay resistance measurements are correct, the spindle motor is defective and must be changed (refer to paragraph 5-23).

4-39. DISC MECHANISM TROUBLESHOOTING

Disc system malfunctions usually generate a system error message; however, these system messages are usually too general to allow isolation of the problem. More specific error information is available from the disc controller in the form of TERRORS and D-ERRORS, which are recorded in both the drive status message and the disc fault log. The TERRORS can also be accessed by using the supplemental mode of the self-test (refer to paragraph 4-7). In addition, the disc error logs (Run, ERT) contain data error information helpful in pinpointing the faulty assembly. Details on the contents of these logs and how to access them are contained in the *CS/80 External Exerciser Manual,* part number 5955-3462.

The TERROR and DERROR information obtained from the drive is essential for isolating the failure to the faulty assembly. Using tables 4-7 and 4-8, locate the appropriate error code and check all the suspect hardware indicated. All field replaceable hardware should be checked before replacing the disc mechanism.

The external exerciser should always be used before replacing the disc mechanism. If the drive is hung-up, it may not be possible to address the drive until the controller is reset to a known state. Use the exerciser SDCLEAR command to force the drive to terminate its current operation and enter the reporting state. If it is necessary to isolate the disc from system problems, the exerciser should be run using an HP-85. When using the HP-85, if an excerciser command does not complete normally and a "Unit n requires service" message is returned, set the unit number to "n", request status, then try the command again.

4-40. DATA ERROR LOGGING

Data errors that occur during disc read operations are logged in the Run log (if they occur during run-time operation) or the disc ERT log (if they occur during an ERT). This error information can be used to assess the integrity of the disc media and also to estimate the error rate of the read/write system. Defective sectors can be located and spared (refer to paragraph 4-42) and potential hardware problems can be identified.

4-41. Disc Run Log. The Run log contains any read data errors that have occurred during normal run

time operation. If there are problems with data integrity, the contents of the Run log should be retrieved and analyzed. Although both correctable and uncorrectable errors are recorded in the Run log, sector addresses are logged only for uncorrectable errors. The error byte returned with each uncorrectable error indicates whether the sector is recoverable or unrecoverable.

To use the Run log error data in isolating disc problems, proceed as follows:

a. Retrieve and record the error information for all heads on the disc.

b. Test and, if necessary, spare each uncorrectable sector (refer to paragraph 4-42).

c. Using the error data recorded in step a, compute the total number of sectors read and the total number of each type of error by adding the corresponding values for each individual head. If the error totals exceed the following guidelines, an ERT should be run to check the operation of the read/write system and sparing performed when appropriate (refer to paragraph 4-42).

   - Unrecoverable errors should not occur during normal operation. This type of error may be caused by a media defect or a failure in the read/write hardware.
   - Recoverable/Uncorrectable errors should not exceed 2 unique addresses per 5,000,000 sectors read. These errors may be caused by a defective head, a media defect, a noise problem, or a failure in the read/write hardware.
   - Correctable errors can occur without compromising data integrity or performance. However, if the error rate exceeds 10 errors per 500,000 sectors read, an ERT should be performed on the disc.

Note: A concentration of errors on a single head may indicate a defective head or media surface. On HP 7912 and HP 7914 disc/tape drives, not more than one-third of the total errors should be concentrated on a single head. On HP 7911 disc/tape drives, not more than two-thirds of the total errors should occur on a single head. If exceeded, an ERT should be run on the suspect head to verify the fault.

4-42. Disc Sparing. If the error codes or the Run log entries indicate a potential problem with the disc media, it may be necessary to locate any defective sectors and spare them.

To perform a sparing operation, proceed as follows:

a. Read the contents of the Run log or ERT log to determine the location of any suspect sectors.

b. Select a suspect sector and run an ERT on it. If the data has been backed-up, run 100 passes of the write-then-read (WTR) ERT; if the data has not been saved, run 200 passes of a read-only (RO) ERT. Log the results in the ERT log.

c. Read the ERT log.

d. Spare all sectors that are unrecoverable and uncorrectable. Also spare any sectors that are repeatedly recoverable and uncorrectable. If the sector is correctable, sparing is usually not necessary; however, if the sector is repeatedly correctable, sparing may be advisable.

Repeat steps b through d for each suspect sector.

4-43. Disc Error Rate Test (ERT). The disc ERT is used to test the read/write system, to establish media integrity, and to locate potentially defective sectors. There are two types of ERT's: the read-only (RO) ERT is nondestructive to user data; the write-then-read (WTR) ERT destroys user data. The WTR ERT should be used only if the user data has been backed up or if the loss of user data is acceptable. Detailed information on the disc ERT is contained in the *CS/80 External Exerciser Manual*, part number 5955-3462.

To test the media surfaces, proceed as follows:

a. Run one full-volume WTR ERT (if possible). Log the results in the ERT log.

b. Run the following number of full-volume passes of the RO ERT: 20 on HP 7911 and HP 7912 disc/tape drives; 10 on HP 7914 disc/tape drives. Log the results of the tests in the ERT log.

c. Read the ERT log and use the following guidelines to interpret the results:

   - Many correctable or uncorrectable errors on one or two specific heads may indicate a defective head or a media defect. Spare any potentially defective sectors and if errors continue to occur, the R/W PCA-A8 and the disc mechanism are suspect and should be thoroughly checked.
   - Many unrepeatable, randomly distributed errors indicate a possible noise problem in the read/write system. Check all ground connections, power line noise, and any other potential sources of RFI. Also ensure that there is good electrical ground contact between the large motherboard mounting bracket and the card cage. The star washer on the mounting bracket ensures good contact. A defective R/W PCA-A8 could also cause this problem.

- If the Run log showed many occurrences of correctable and recoverable errors, but the ERT log shows fewer occurrences for the same number of sectors read, the run-time errors may have been caused by noise problems during data transfers. Check the HP-IB cable(s), HP-IB PCA-A14, HP-IB grounds on the host and the disc/tape drive, and all ground connections.

- Errors which occur repeatedly during a RO ERT but disappear when a WTR ERT is run may indicate a transient write problem. The read/write hardware (R/W PCA-A8, DMA PCA-A4, disc mechanism) should be checked thoroughly.

Note: The guidelines concerning the number and types of errors in the ERT log are identical to those used for the Run log (refer to paragraph 4-41).

If it is necessary to perform sparing operations, retest the media surface by repeating steps a through c. If more errors occur, a more thorough test of the read/write system may be required. To fully test the read/write system, proceed as follows:

a. Run the following number of full-volume passes of the WTR ERT: 20 on HP 7911 and HP 7912 disc/tape drives; 10 on HP 7914 disc/tape drives. Log the results of the tests in the ERT log.

b. Read the ERT log. If the number and types of errors exceed the guidelines specified in paragraph 4-41, perform sparing operations as necessary (refer to paragraph 4-42).

c. Rerun the tests performed in step a, and read the results in the ERT log. If errors continue to occur, the following hardware is suspect and should be checked thoroughly: R/W PCA-A8, DMA PCA-A4, Servo PCA-A9, disc mechanism.

4-44. DISC MEDIA INITIALIZATION

Initialization of the disc media may be necessary to solve certain disc system problems. Disc initialization is performed using the CS/80 External Exerciser. The user has the option of initializing only the maintenance tracks (option I) or only the data tracks (option B or P, depending on which spares will be retained).

CAUTION

Initialization of the maintenance tracks (option I) can only be performed using REV 5.0 firmware. DO NOT use option I with earlier versions of firmware.

If the drive exhibits maintenance track problems (e.g., DERRORs 197 and 198), the maintenance tracks should be initialized. To initialize the maintenance tracks, perform the following steps:

a. Using the REV command, ensure that REV 5.0 firmware is installed in the drive. Do not proceed with the next step until REV 5.0 firmware is installed in the drive.

b. Execute the INIT MEDIA command using option I.

If the drive is experiencing read/write problems and the media is suspect, the data surfaces of the disc should be initialized. The recommended procedure for initializing the data tracks is to initialize retaining all spares (option B). An alternative method of initialization is to initialize retaining only primary spares (option P). Although more involved and time comsuming, this option is useful if a hardware failure has occurred that may have resulted in unnecessary sparing operations. Following an initialization retaining only primary spares, an ERT must be run to locate and spare those areas of the media that are indeed defective.

CAUTION

Initialization of the data surfaces destroys all data on the disc.

To initialize the data tracks, perform the following steps:

a. Using the SAVE switch, backup the contents of the disc onto a tape cartridge. (Certain hardware faults may abort this operation.)

Note: The SAVE switch is inoperative on dual controller drives (HP 3000 systems). The contents of the disc will have to be backed up using system level routines.

b. Read and save the disc logs (Fault, Run, ERT).

c. Initialize the media retaining all spares (option B) or retaining only primary spares (option P). Use an interleave value of 1.

If only primary spares were retained, proceed with the following steps:

d. Run the following number of full-volume passes of the WTR ERT: 10 for the HP 7911 and HP 7912; 5 for the HP 7914.

e. Read the ERT log. Spare all sectors that are unrecoverable and uncorrectable. Also spare any sectors that are repeatedly recoverable and uncorrectable. If the sector is correctable, sparing is usually not necessary; however, if the sector is repeatedly correctable, sparing may be advisable.

4-45. DISC MECHANISM COMPATIBILITY

When replacing the disc mechanism, Servo PCA-A9, or R/W PCA-A8, the proper parts compatibility must be maintained. Table 4-3 shows the acceptable hardware configurations.

4-46. TAPE SYSTEM TROUBLESHOOTING

Tape system problems can be isolated to the faulty assembly using the drive's internal diagnostic routines and error logging (see figure 4-7). Because the tape mechanism must be replaced as an entire unit, all other suspect hardware should be thoroughly checked before changing the mechanism itself.

To isolate the faulty assembly, proceed as follows:

a. Clean the tape head and capstan.

b. Run self-test.

Note: Self-test cannot be run on a drive connected to an HP 3000 host computer.

c. Retrieve and interpret the drive status message. Detailed instructions on interpreting the contents of the status message are contained in the *CS/80 Instruction Set Programming Manual,* part number 5955-3442. The method of accessing the status message depends on the type of host system in use:

- On HP 3000 systems, the system utility LISTLOG2 is used to retrieve the status message. If available, the system utility CS80UTIL can be used to decode the status message.
- On HP 250 systems, use the DISC STATUS command to retrieve the last two status messages. The last 10 word (20 bytes) of the status message are the drive status bytes.

d. Using the external exerciser, read the tape logs (ERT, Use, Run) and the fault log. Although the fault log resides on the disc, tape-related errors are logged in the fault log, unless the drive is a dual-controller model (HP 3000 systems). These logs accumulate information until they are cleared, except for the Use log, which cannot be cleared. Information on reading, interpreting, and clearing these logs is contained in the *CS/80 External Exerciser Manual,* part number 5955-3462.

Note: Before reading the logs, issue a PRESET command to force any error information in RAM to be updated to the tape logs.

e. Analyze the information retrieved from the status message and the tape logs. If there are any tape-related error codes, they can be decoded using table 4-7 (TERRORS) or table 4-8 (DERRORS). These tables include a list of suspect hardware; check each item until the defective assembly is isolated.

Note: TERROR 21H indicates that an auto-load failure has occurred. The tape status lamps should be used to troubleshoot auto-load failures (see figure 4-3). Use table 4-4 to isolate the faulty assembly.

Table 4-3. Disc Mechanism Replacement Parts Compatibility

REPLACEMENT PART	COMPATIBLE WITH									
	Servo A9				Read/Write A8			Mechanism		
	07912-6X001	07912-6X121	07914-6X001	07912-6X004	07912-6X104	07914-6X004	07914-6X104	07911/07912-6X100	07911/07912-6X200	07914-6X100
Servo A9										
07912-6X121	—	—	—	No	Yes	Yes	No	Yes	No	No
07914-6X001	—	—	—	No	Yes	Yes	Yes	Yes	Yes	Yes
Read/Write A8										
07912-6X104	No	Yes	Yes	—	—	—	—	Yes	Yes	No
07914-6X004	No	Yes	Yes	—	—	—	—	Yes	Yes	Yes
07914-6X104	No	No	Yes	—	—	—	—	No	No	Yes
Mechanism										
07911/12-6X100	No	Yes	Yes	No	Yes	Yes	No	—	—	—
07911/12-6X200	No	No	Yes	No	Yes	Yes	No	—	—	—
07914-6X100	No	No	Yes	No	No	Yes	Yes	—	—	—

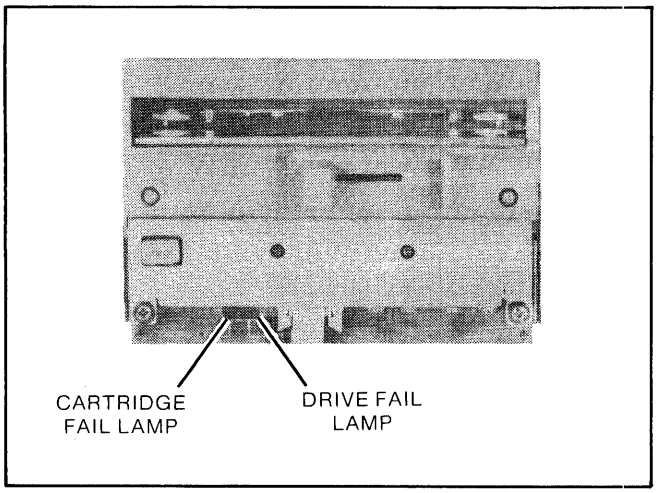


Figure 4-3. Tape Mechanism Status Display

If no tape-related error codes are returned in the status message or the fault log, the information in the tape logs (ERT, Run, Use) will have to be used to isolate the problem.

The Use log indicates if the tape cartridge has exceeded the recommended maximum usage of 2500 cycles (BOT to EOT to BOT). This equates to approximately 20,480,000 blocks on a 600-foot tape and 5,120,000 blocks on a 150-foot tape.

The Run log records any uncorrectable or unlocatable errors that have occurred. A tape ERT should be run if an uncorrectable error has occurred, or if an excessive number of unlocatable errors have occurred (> 128 for a 600-foot tape; > 32 for a 150-foot tape).

4-47. TAPE SYSTEM ERT

Before changing the tape mechanism, an ERT should be run to isolate the problem to the tape media or the tape mechanism. A tape ERT is run using the TAPE program of the external exerciser. To run an ERT on the tape, proceed as follows:

a. Clean the tape head.

b. Ensure that the tape is not write protected.

c. Retrieve the existing tape ERT log contents for use as historical data.

d. Clear the existing tape ERT log.

e. Select and run the appropriate tape ERT. Use the values shown in table 4-5 in response to the exerciser prompts.

f. When the test is complete, read the tape ERT log and compare the results with the values shown in table 4-6, which shows the maximum limits for a tape ERT.

g. The flag plot generated during the ERT should be retrieved and examined. The error patterns on the

Table 4-4. Autoload Tape Mechanism Status LED's (TERROR 21H)

CARTRIDGE FAILURE* (Left Lamp)	DRIVE FAILURE* (Right Lamp)	CAUSE	ACTION
OFF	OFF	1) Normal	1) None
OFF	ON	1) Dirty head	1) Clean head
		2) Worn cartridge**	2) Replace cartridge
		3) Bad mechanism	3) Replace mechanism
ON	OFF	1) Wrong cartridge type or abnormal motor load	1) Use proper type cartridge or replace cartridge†
		2) Dirty head	2) Clean head
ON	ON	1) Tape erasure or head off tape	1) Replace TIB PCA or tape mechanism
		2) Tape may have despooled	2) Respool the tape or use new tape

* *LED's stay lit until another cartridge is inserted.*

** *If two or more tapes exhibit problem, then replace mechanism.*

† *Only formatted cartridges can be used; if tape is degaussed it is ruined. If tape has wound off hub, rotate the drive wheel until four revolutions of tape wind onto the small spool and try autoload again. This should only occur with a new tape; if the tape is old then the mechanism is at fault.*

Table 4-5. Tape ERT Responses

EXERCISER PROMPT	RESPONSE	
	RO ERT	WTR ERT
Test Name	RO ERT	WTR ERT
Continue	N/A	Yes
Loop Count	1	1
Addresses, Tracks, or Tape	C (L*)	C (L*)
New Block Address	0	0
Tape Length	All (16000**)	All (8000**)
Pattern Source	N/A	RN

*Response for External Exerciser Rev 2645 and later.
**Response for partial ERT.

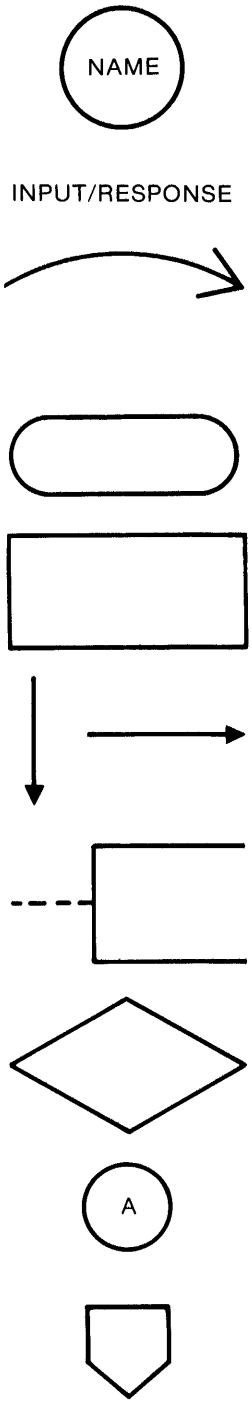
tape can be an indication of the type of problem occurring:

- Permanent errors (+) grouped at BOT (0000) on odd tracks only. As the track number increases, the number of errors increases and the errors may occur over a larger portion of the track. This pattern indicates instantaneous speed variations (ISV) and is caused by a defective tape.
- A pattern similar to that described above, but also with permanent errors grouped at EOT (1021 or 4087) on the even tracks. This is also ISV and is caused by a defective tape.
- Permanent error clumping (horizontal). This pattern is an indication of one of the following conditions: a dirty tape head; tape drive is not 07908-6X340; defective media. If errors occur only on the outside tracks (0 and 1 or 14 and 15) the tape has sustained edge damage and should be discarded.
- Permanent and/or Unlocatable (K) error clumping (vertical). This pattern is typical of contamination. Look for evidence of white powder on the tape friction pins and on the cartridge drive belt. Replace the contaminated tape cartridge and clean the tape head and capstan.
- Excessive spares, vertical clumping (usually on alternating tracks). This indicates poor formatting of the tape by the manufacturer. This is not a problem unless all the spares have been used.

Table 4-6. Maximum Tape ERT Values

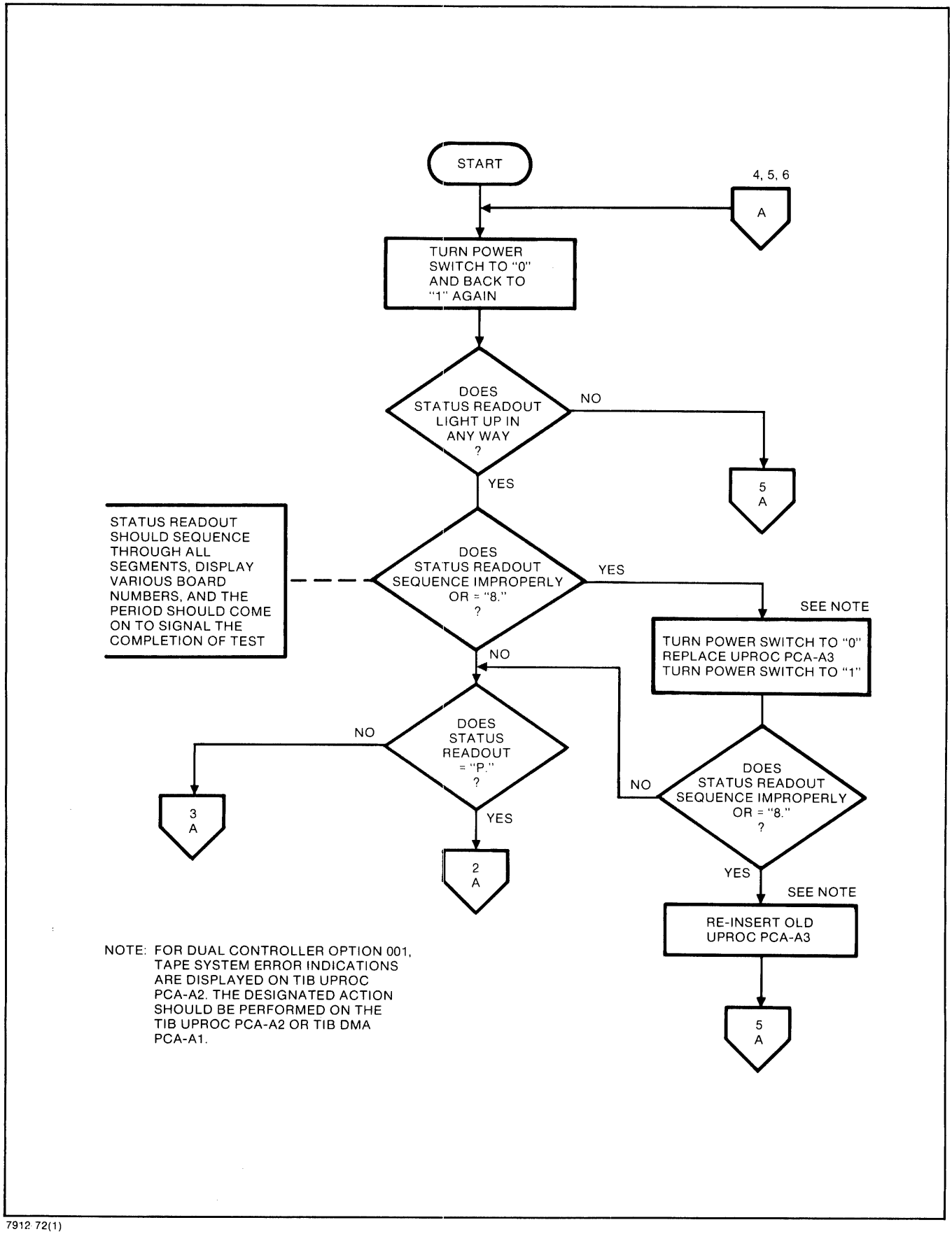
ITEM	FULL TEST				PARTIAL TEST
	600-FT TAPE		150-FT TAPE		150/600-FT TAPE
	WTR	RO	WTR	RO	WTR or RO
Blocks Accessed	130816*	65408*	32704*	16352*	16000
Correctable Errors:					
Permanent	250	250	128	128	64
Transients	N/A	N/A	N/A	N/A	N/A
Uncorrectable Blocks	0	1	0	1	1
Unlocatable Blocks	15	N/A	10	N/A	10

*These values may vary if the cartridge is not certified.

SYMBOL	DESCRIPTION
	**A. State Diagram Symbols** STATE SYMBOL. This symbol indicates the current condition a device is in. The symbol contains the name of the state. INPUT. Information read from an external source (such as a switch) which causes a response. RESPONSE. The output caused by a certain input while in a certain state. TRANSITION. The path from one state to another or from one state to itself. **B. Flowchart Symbols** TERMINAL SYMBOL. This symbol indicates the start or end of the operations named by the title of the flowchart. PROCESS SYMBOL. This symbol indicates the execution of a defined operation. FLOWLINE SYMBOL. This symbol indicates the logical path to follow in the flowchart. ANNOTATION SYMBOL. This symbol is used for descriptive comment in the flowchart. DECISION SYMBOL. This symbol requires a choice of logical paths. This choice of paths depends on the answer to the question contained in the symbol. ON-PAGE CONNECTOR. This symbol indicates that the flow line is continued at another such symbol elsewhere on the sheet. OFF-PAGE CONNECTOR. This symbol designates entry or exit from a page. EXIT from a page 2 A Go to sheet 2, block A. ENTRY from a page 1, 2 A Continued from sheet 1 or 2. Block A

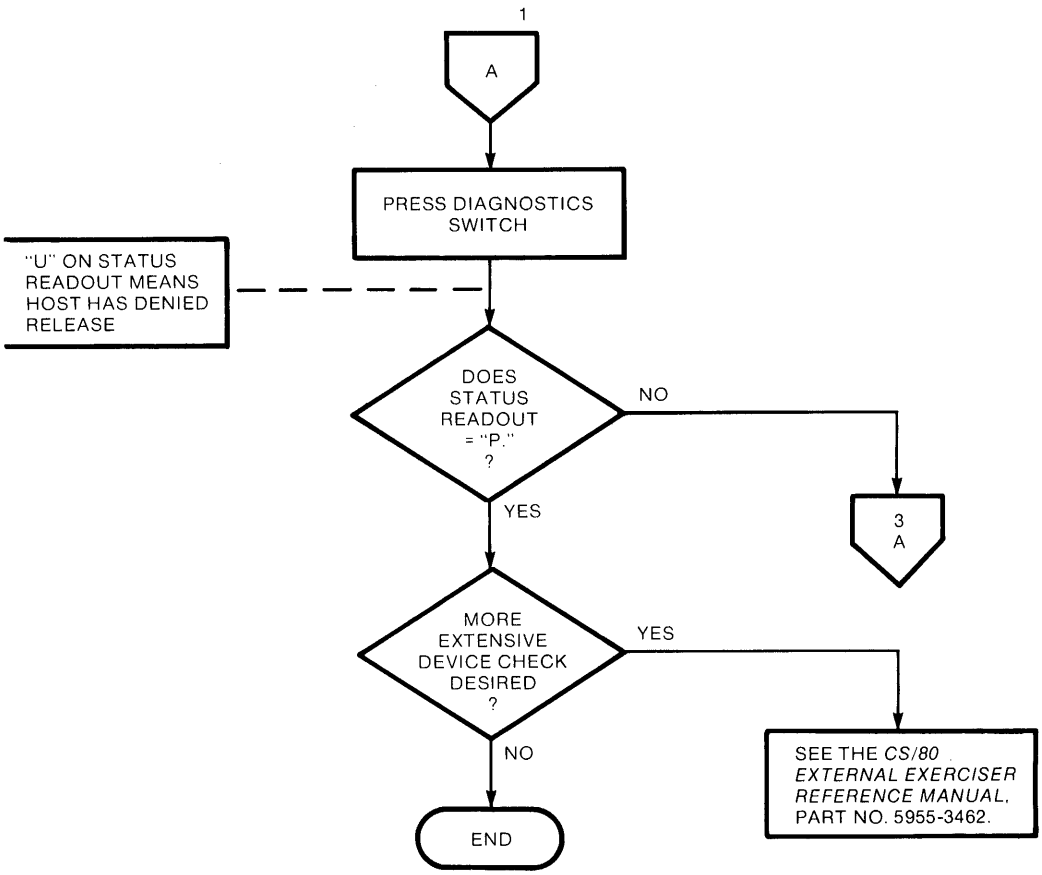
7912-84

Figure 4-4. Flowchart and State Diagram Symbols



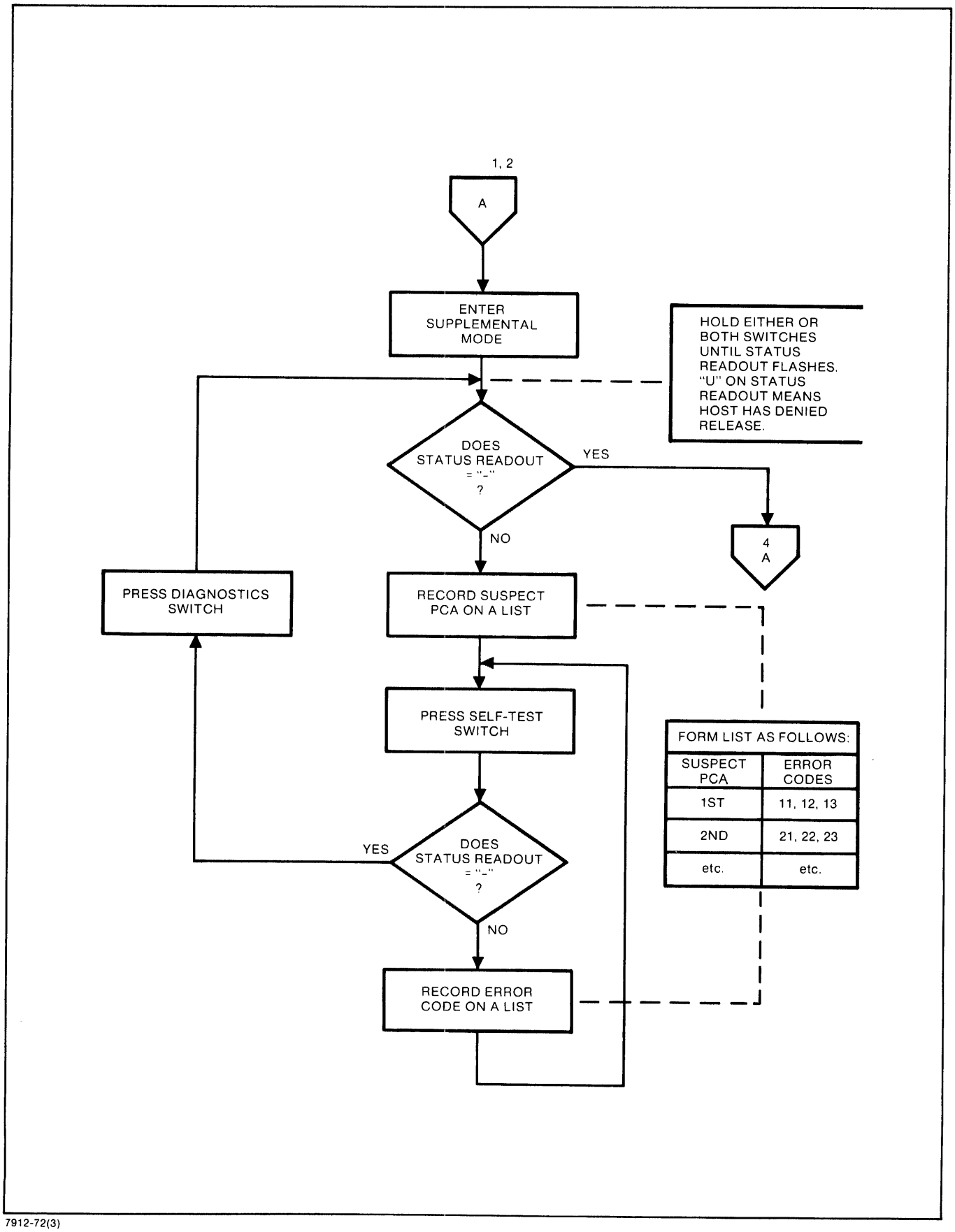
7912-72(1)

Figure 4-5. Troubleshooting Flowchart (Sheet 1 of 6)



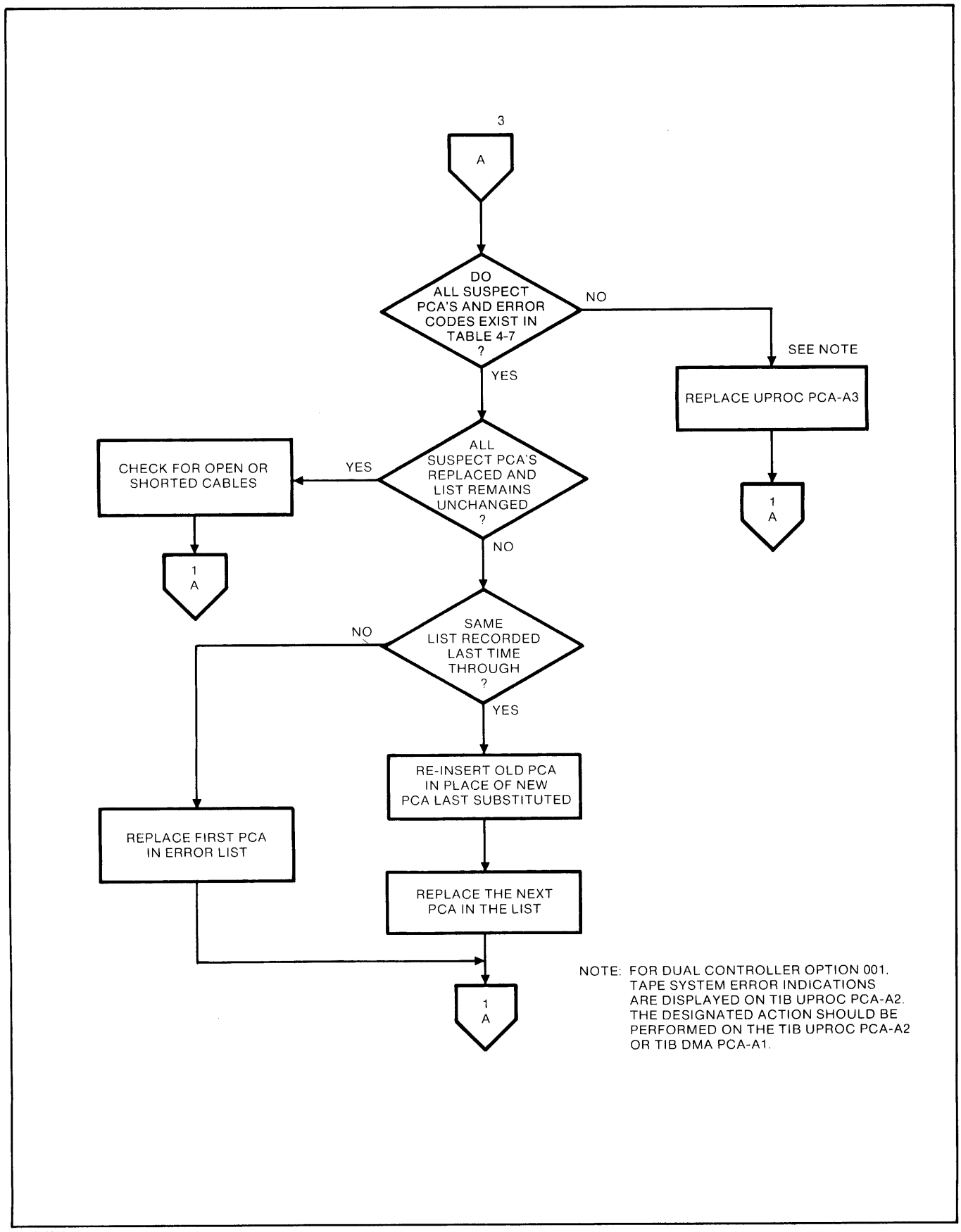
7912-72(2)

Figure 4-5. Troubleshooting Flowchart (Sheet 2 of 6)



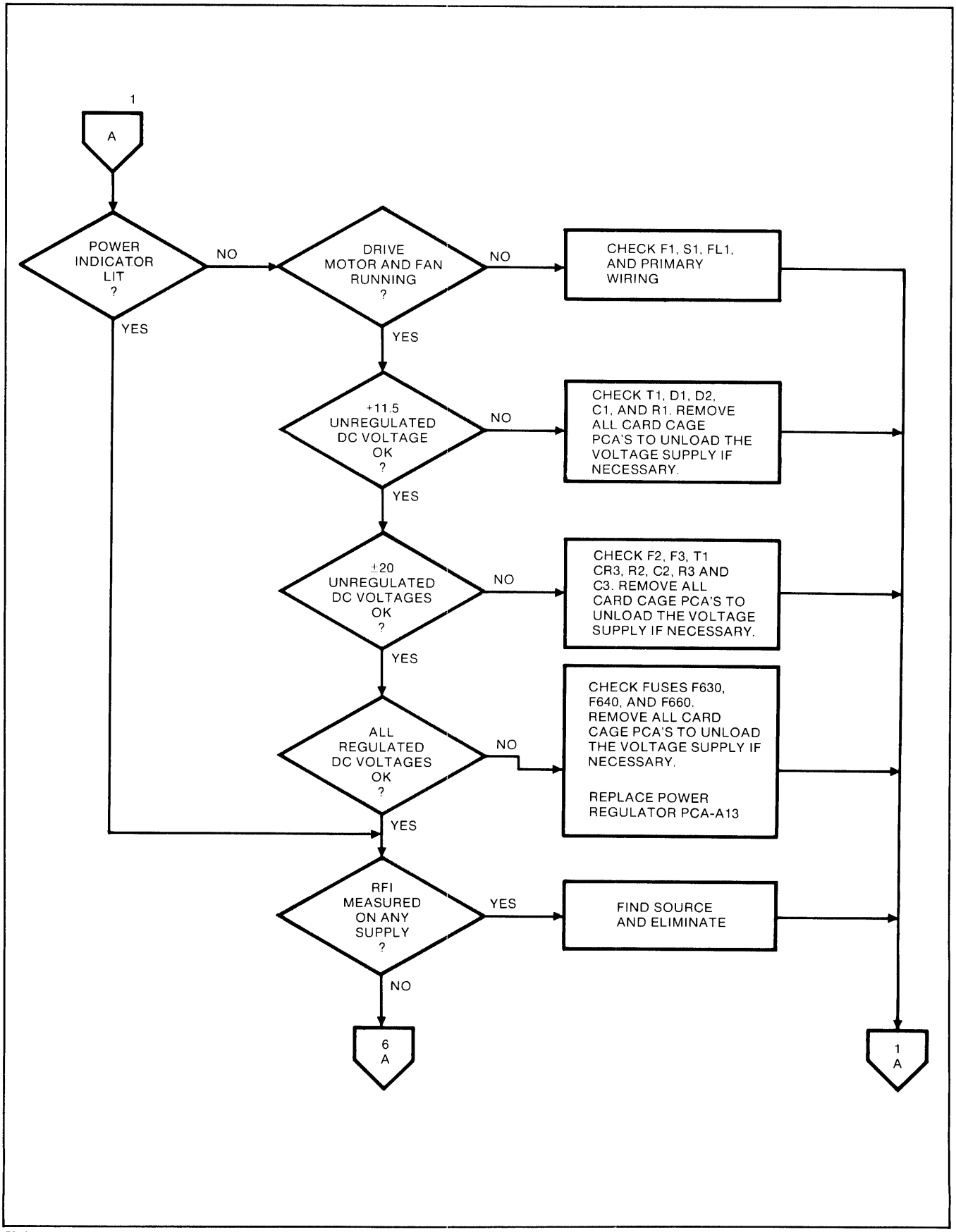
7912-72(3)

Figure 4-5. Troubleshooting Flowchart (Sheet 3 of 6)



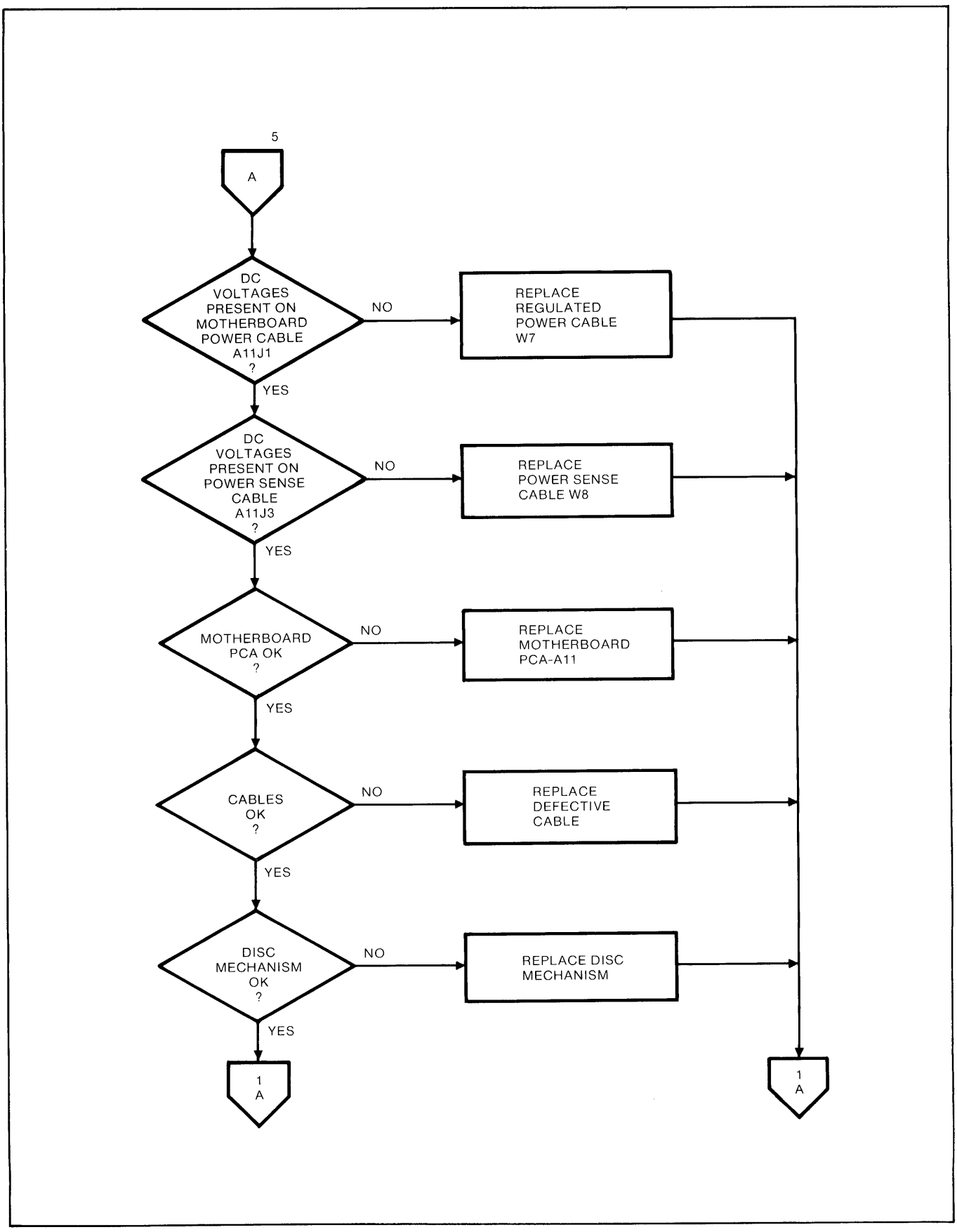
7912-72(4)

Figure 4-5. Troubleshooting Flowchart (Sheet 4 of 6)



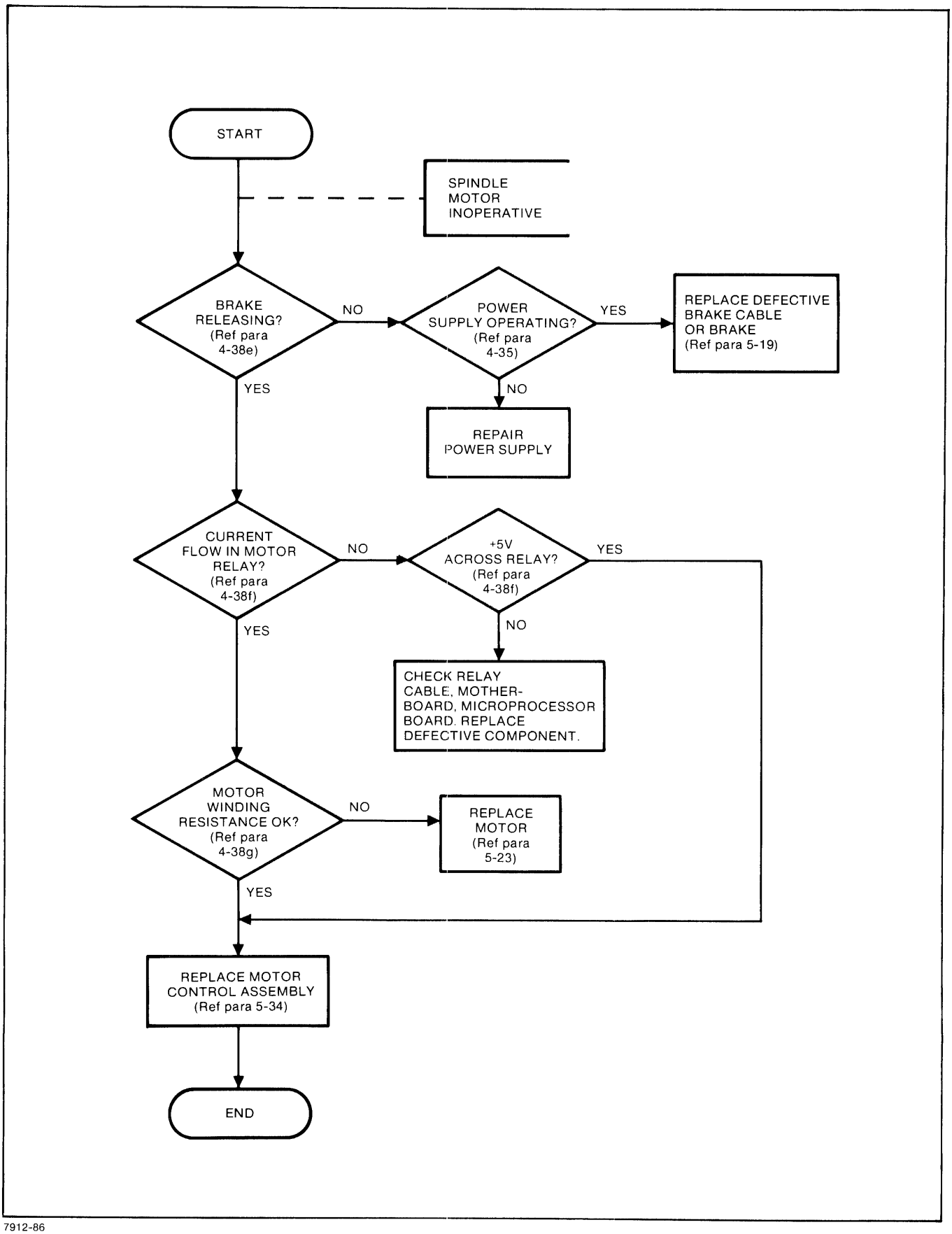
7912-72(5)

Figure 4-5. Troubleshooting Flowchart (Sheet 5 of 6)



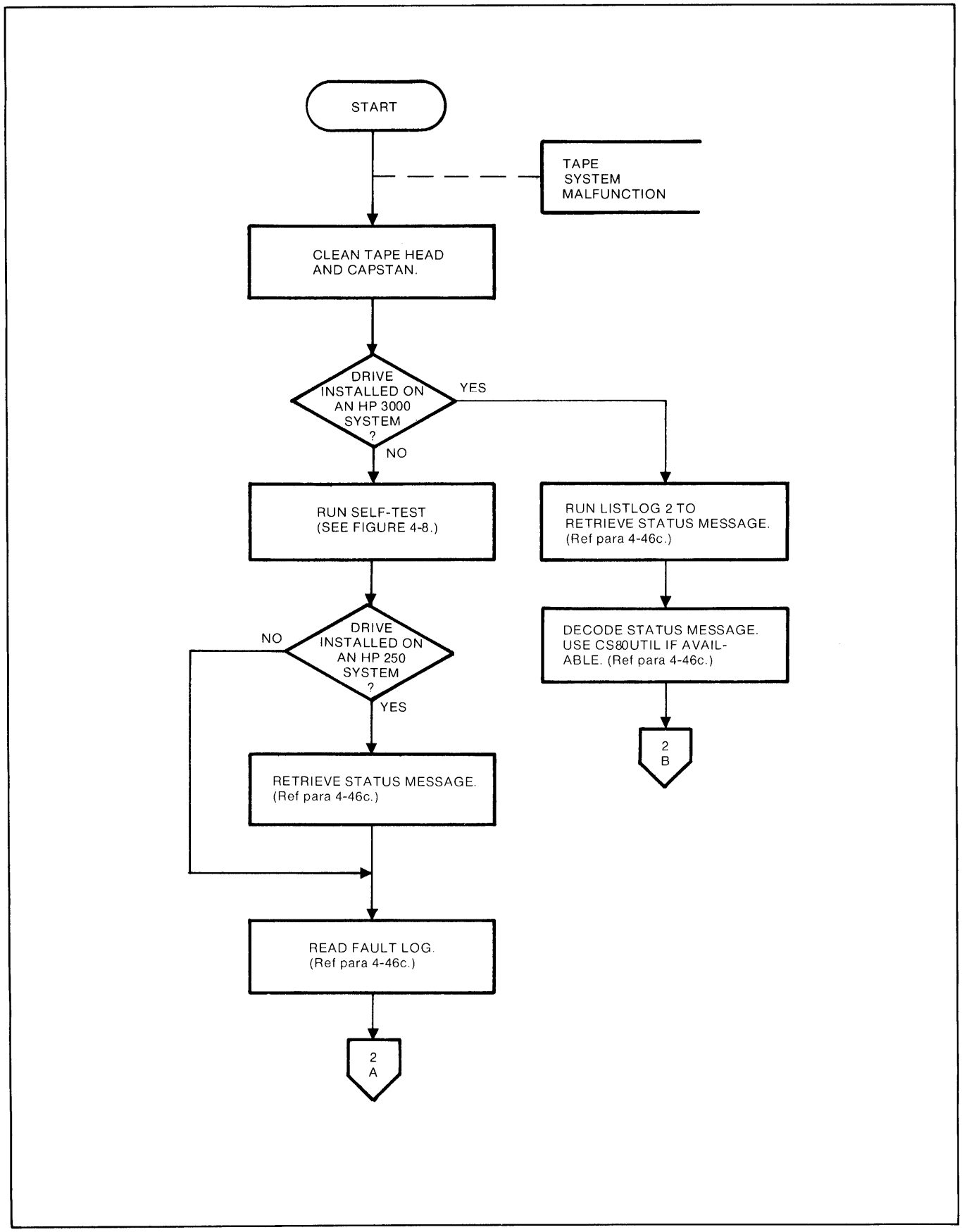
7912-72(6)

Figure 4-5. Troubleshooting Flowchart (Sheet 6 of 6)



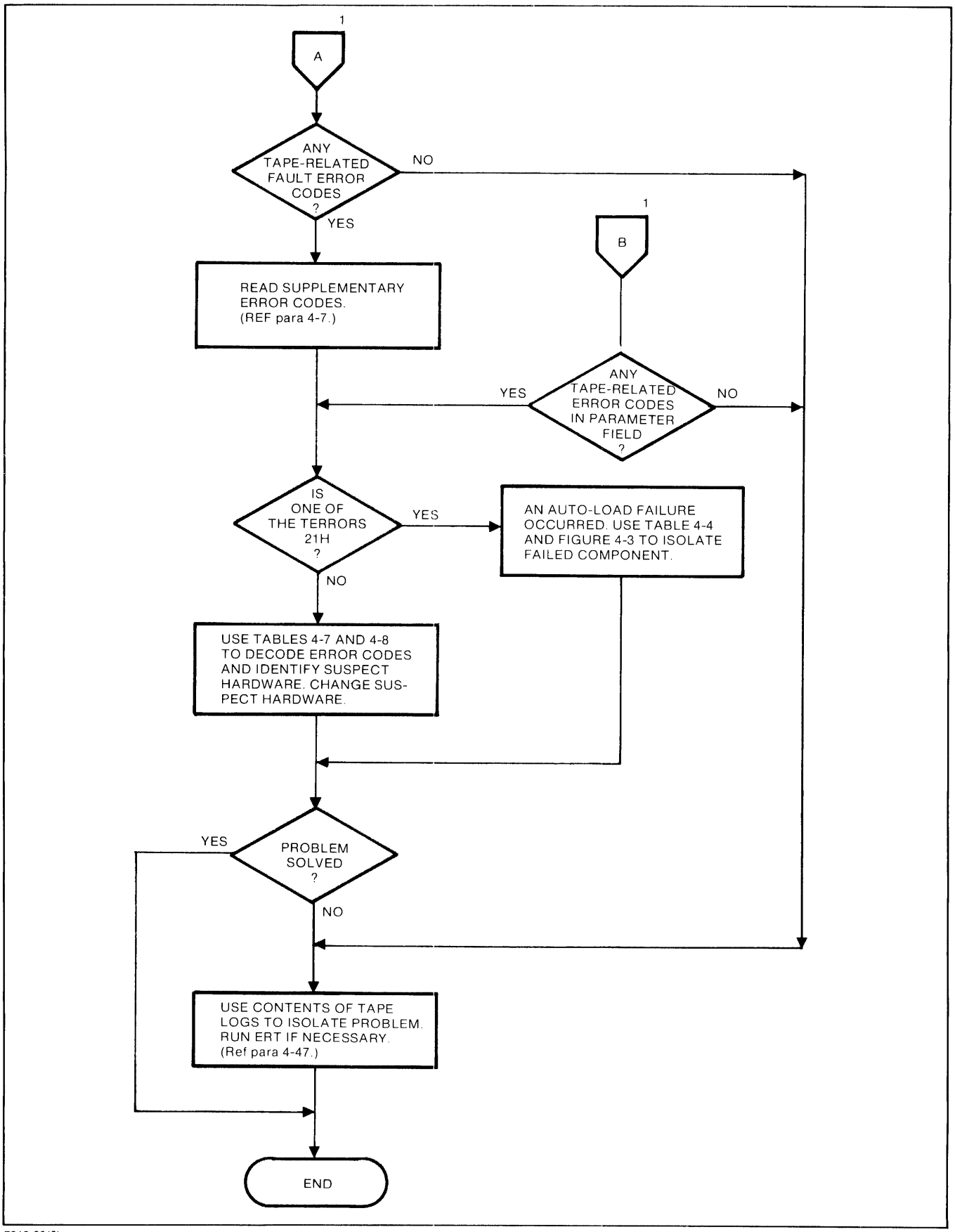
7912-86

Figure 4-6. Spindle Motor Troubleshooting Flowchart



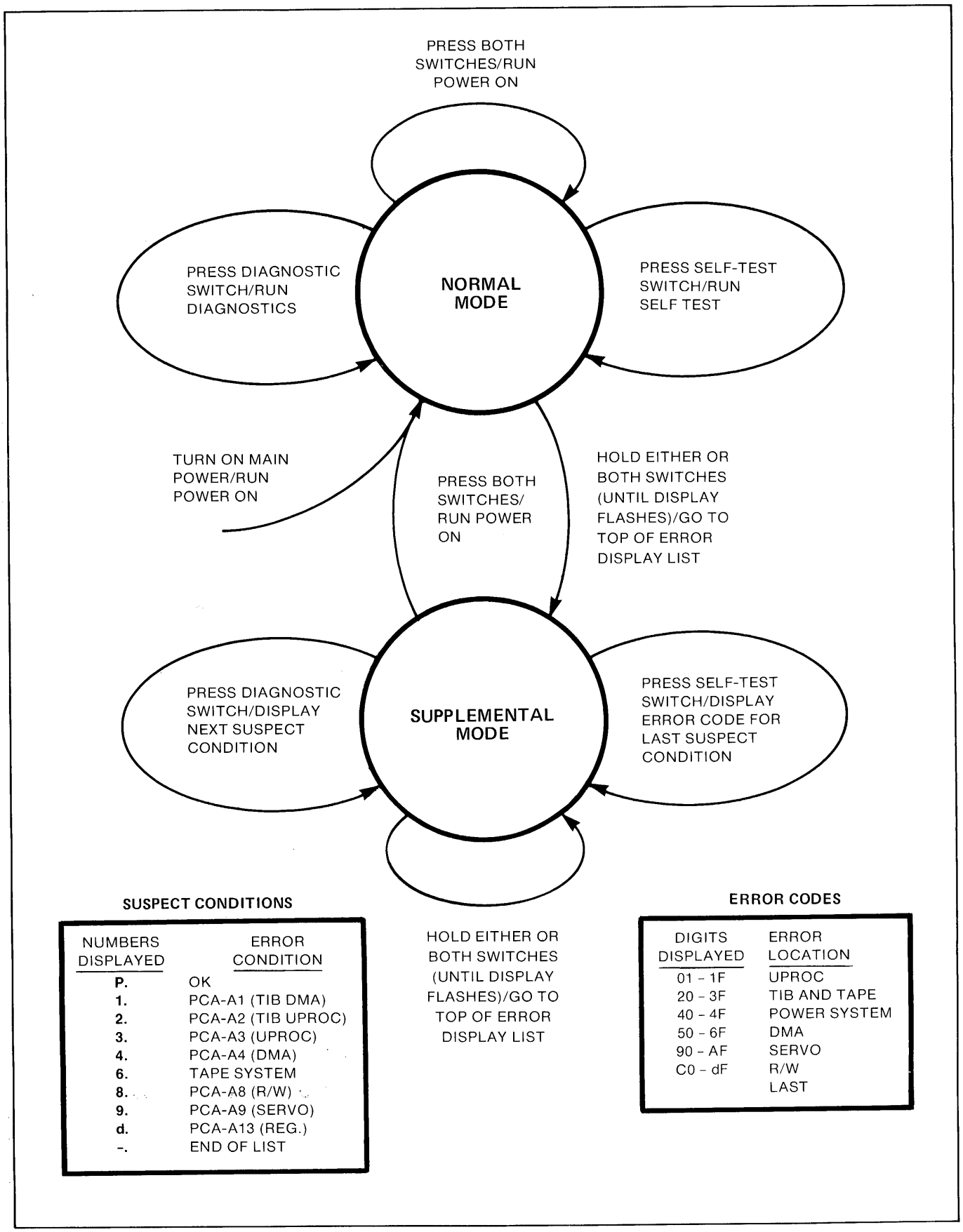
7912-90(1)

Figure 4-7. Tape System Troubleshooting Flowchart (Sheet 1 of 2)



7912-90(2)

Figure 4-7. Tape System Troubleshooting Flowchart (Sheet 2 of 2)



REF 7908-31

Figure 4-8. Internal Diagnostic States

Table 4-7. Internal Diagnostic Test Error Codes

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
1	01	MPU RAM data miscompare error during self-test.	1) MPU PCA (RAM, Z-80, or Data/Address bus)
2	02	Incorrect MPU ROM checksum found during self-test.	1) MPU PCA (EPROM, ROM, Data/Address bus or Z-80) 2) Another PCA is corrupting the common data bus
3	03	CTC self-test or diagnostic failure of any of 5 diagnostic tests for the counter timer circuit.	1) MPU PCA (CTC, Z-80 interrupt circuit, or data/address bus)
4	04	Cannot write to the 4-bit tape counter during a diagnostic. A write/read check of the tape 4-bit counter failed.	1) MPU PCA (tape counter) 2) TIB PCA (tape counter control circuitry CTCT-H)
5	05	Addressing problems found during self-test. Any of the controller or interface PCAs may be responding to an illegal address.	1) MPU PCA (addressing circuits) 2) Any PCA which shares the address bus (DMA, read/write, servo)
6	06	Bus corruption found during self test. Data bus failure on the common MPU bus.	1) MPU PCA (data bus latches) 2) Any PCA which shares the common data bus (DMA, read/write, servo)
7	07	Bad response to bus select during self-test. DMA, read/write, or servo PCA decode failure.	1) MPU PCA 2) Any of the selected PCAs (DMA, read/write, servo)
8	08	MPU RAM failure found during self-test or background tests.	1) MPU PCA (RAM) 2) Data or address bus

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
9	09	The Z-80 did not respond to the LINT-L generated by the PHI during a self-test. LINT-L circuitry is not operational.	1) MPU PCA (LINT-L to Z-80 circuit) 2) DMA PCA (PHI interrupt circuit)
10	0A	The controller did not detect either a disc or tape unit. The TIB, read/write, and/or servo PCA is not connected to the MPU bus.	1) Read/write, servo, or TIB not plugged into motherboard
11	0b	Either or both of the MPU self-test switches is continuously active for more than 30 seconds. MPU switches register active for too long.	1) MPU PCA (self-test switches may be stuck in the active state)
12	0C	The CPU trapped an illegal opcode. An illegal instruction was encountered.	1) MPU PCA (Z-80 or ROM)
15	0F	One of the previously mentioned errors has occured (01_{16}- $0C_{16}$). This error is an "or" of the RAM, ROM, CTC, and tape counter errors, and is used by the isolation routine as one place to look for general MPU health. See the descriptions for the TERRORS "01_{16}- $0C_{16}$".	1) MPU PCA
16	10	The sector pulse is not incrementing the CTC circuit during a read/write self-test. The counter timer circuit is not operational.	1) MPU PCA (CTC or Z-80 interrupt) 2) Disc or read/write PCA not providing sector pulse
32	20	Cartridge not inserted.	1) Tape not inserted 2) Tape data cable 3) Tape mechanism (does not see the tape)
33	21	Tape did not meet the requirements for loading (tension, key readability, etc.).	See Table 4-4 for information on troubleshooting autoload failures.

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
34	22	The MPU read illegal status from the tape drive (routed through the TIB PCA).	1) TIB PCA 2) MPU PCA 3) Tape data cable 4) Tape mechanism
35	23	CRC circuitry on the TIB is not correcting errors.	1) TIB PCA
37	25	Manufacturer's block unreadable. The tape may be of the wrong type (i.e., not made for use in the tape drive).	1) TIB PCA 2) Dirty tape head (visible debris) 3) Tape media (cartridge) 4) Tape mechanism
38	26	The sector toggle flip-flop cannot be made to function from the TIB PCA. Tape/DMA interface circuits are not functioning properly.	1) TIB PCA 2) DMA PCA
39	27	The DMA to TIB loopback failed, and the ability of the TIB to source a known pattern failed.	1) TIB PCA 2) DMA PCA
40	28	The DMA-TIB loopback test failed but the test where the TIB sources a pattern to the DMA has passed (cannot write, but can read).	1) TIB PCA 2) DMA PCA
41	29	The address counter did not increment by four sectors when the TIB sent one block (1k) to the DMA. TIB/DMA interface circuits failed.	1) DMA PCA 2) TIB PCA
42	2A	The TIB is failing to sequence the four frames within the 1k block.	1) TIB PCA

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
43	2b	Timeout error for TIB sourcing the known pattern to the DMA. The TIB is not responding to self-test mode control, by sending a known buffer of data.	1) TIB PCA 2) DMA PCA
44	2C	Unable to write to self-test system blocks and cannot read keys.	1) TIB PCA 2) Tape media (cartridge) 3) Tape mechanism
45	2d	Could not read from the system test blocks during self-test. Tape unreadable at the system block area. Could not read keys or frame headers.	1) TIB PCA 2) Tape media (cartridge) 3) Tape mechanism
46	2E	The data read back from the tape did not compare with the data written.	1) TIB PCA 2) DMA PCA
64	40	The fault latch bit which indicates a possible power fail (PPF-L) is set. This bit is tested during the read/write diagnostic.	1) Regulator PCA 2) Servo PCA (fault register)
80	50	DMA self-test control and status registers cannot be properly read.	1) DMA or MPU PCA (DMA/MPU interface)
81	51	During DMA self-test, the MPU could not read and write to every location in the 16-byte header.	1) DMA PCA (header RAM) 2) MPU PCA (interface/data bus)
82	52	The MPU cannot read and write to every location in the 4k DMA data RAM.	1) DMA PCA (data RAM) 2) MPU (interface/data bus)
83	53	The data field bit is incorrect or the disc address counter points to the wrong area.	1) DMA PCA (disc interface, ECC chip) 2) Read/write PCA

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
84	54	Data compare error during a disc read (occurs if header, data, CRC, ECC byte is wrong).	1) DMA PCA (disc interface, ECC chip) 2) Read/write PCA
85	55	The CRC error bit is set during a read of a good sector, or is not set during a read of a bad sector.	1) DMA PCA (CRC circuit)
86	56	The sector counter did not increment after the read of a good sector or the sector counter did not decrement after a sector had been written to the disc.	1) DMA PCA (sector counter circuits)
87	57	DMA self-test data compare error of any sector byte during a disc write.	1) DMA PCA (disc interface, ECC chip) 2) Read/write PCA
88	58	Unused signal line(s) are being pulled low by another PCA.	1) DMA PCA (read/write interface, ECC chip)
89	59	The disc address counter did not increment after a sector was read from the disc.	1) DMA PCA (disc address counter) 2) Read/write PCA (interface circuitry)
91	5B	The ECC-to-formatter/seperator interface test failed. The ECC-to-formatter/seperator interface lines are probably faulty.	1) DMA PCA (ECC circuitry) 2) Read/write PCA (interface circuitry)
92	5C	The ECC-to-DMA or the ECC-to-MPU interface test failed. The ECC-to-DMA or the ECC-to-MPU interface lines may be faulty.	1) MPU PCA 2) DMA PCA
93	5d	An internal function of the ECC failed.	1) DMA PCA (ECC chip)

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER DEC	NUMBER HEX	CAUSE	SUSPECT HARDWARE
96	60	Improper PHI interrupt bits are set during the PHI diagnostic.	1) DMA PCA (PHI) 2) MPU PCA (PHI to Z-80 interface)
97	61	The PHI self-test microdiagnostic had a FIFO wrap-around data miscompare.	1) DMA PCA (PHI)
98	62	PHI self-test identify bytes were not the same as those loaded.	1) DMA PCA (PHI) 2) MPU PCA
99	63	The byte counter failed during a write operation.	1) DMA PCA (security circuit)
100	64	No EOI was received during a write operation.	1) DMA PCA (PHI) 2) MPU PCA
101	65	A secondary command was not detected during a disc write.	1) DMA PCA (PHI) 2) MPU PCA
102	66	PHI to data RAM data miscompare or data overrun has occurred.	1) DMA PCA (I/O circuits)
103	67	Left-over bytes were not in the inbound FIFO after the buffer became full or the byte count expired during an I/O write (possible overrun).	1) DMA PCA (I/O circuits)
104	68	Transfer stopped in the wrong place during an I/O read (possibly did not stop after sending EOI).	1) DMA PCA (I/O circuits)
105	69	The sector did not increment at the sector boundry on an I/O write.	1) DMA PCA (sector or I/O address counter)
106	6A	The sector counter did not decrement at the sector boundry during an I/O read.	1) DMA PCA (sector or I/O address counter)

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
107	6b	Sector overrun or security circuit malfunction has occurred.	1) DMA PCA (security circuit)
108	6C	A data compare error occurred after an I/O read.	1) DMA PCA (I/O circuits)
109	6d	The DMA I/O counter stopped early.	1) DMA PCA (I/O circuits)
110	6E	The status register bits on the DMA PCA make no sense.	1) DMA PCA
111	6F	The DMA RAM failed the nondestructive RAM test during either the power-on or background test.	1) DMA PCA (RAM)
144	90	The fault register bit which indicates a servo AGC fault (AGC-L) was set when the register was read. A servo AGC fault may have occurred, or the fault register may be failing.	1) Actuator lock may be engaged 2) Servo PCA (check fuses F617 & F717; refer to Appendix A, Service Note no. 7911P/R-11A) 3) Disc mechanism
145	91	The offtrack bit (OFT-L) of the fault register indicated a servo offtrack condition when read. A servo offtrack fault occurred, or the fault register may be bad.	1) Servo PCA (track-following hardware, fault register) 2) Disc mechanism
146	92	A track compare error has occurred during a read/write diagnostic. A header may be incorrect or unreadable, or the servo may have "jumped the track".	1) Servo PCA (track-following hardware) 2) Read/write PCA
148	94	Unable to seek or verify after a successful recalibrate.	1) Servo PCA 2) Read/write PCA

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER DEC	NUMBER HEX	CAUSE	SUSPECT HARDWARE
150	96	Track crossings are not indicated when expected. Track crossing detection is faulty or the device is not crossing tracks. Servo head may be in a zone where servo code is invalid or missing.	1) Servo PCA (refer to Appendix A, Service Note no. 7911P/R-11A) 2) MPU (counter timer chip) 3) Disc mechanism
151	97	The disc does not reach or maintain the minimum specified speed within a reasonable interval.	1) Speed sensor (refer to Appendix A, Service Note no. 7911P/R-9) 2) Servo PCA (refer to Appendix A, Service Note no. 7911P/R-11A) 3) MPU PCA 4) Spindle motor or belt (refer to paragraph 4-38) 5) Disc mechanism
154	9A	The number of allowable offtracks was exceeded during a verify operation. Too many offtracks occurred.	1) Servo PCA 2) Disc mechanism (motor constant too weak or servo resonance)
155	9b	Too many verifies during a verify operation. Verify operation is failing.	1) Read/write PCA 2) Servo PCA 3) Disc mechanism (motor constant too weak or servo resonance)
157	9d	Servo ontrack indicator disagrees with expected state or no ontrack signal after a seek. Seek failed or ontrack indicator is bad.	1) Servo PCA (phase-locked loop, AGC circuitry, track follower circuit, or track crossing and offtrack detection) 2) Disc mechanism (flex circuit)

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER DEC	NUMBER HEX	CAUSE	SUSPECT HARDWARE
170	AA	The fault register speed OK (SOK-H) bit indicates that proper spindle speed has not been restored from a slower spindle speed.	1) Servo PCA (speed indicator, fault register) 2) Spindle motor, belt, or motor control assembly
171	Ab	Could not verify track zero, or an unrecognizable DERROR was reported from the recalibrate operation.	1) Actuator lock may be engaged 2) Servo PCA (refer to Appendix A, Service Note no. 7911P/R-11A) 3) Disc mechanism
172	AC	The device has attempted to force an offtrack condition by sending a very large offset command to the servo. No offtrack was indicated on the servo PCA. The device may not be over servo code, the servo offset circuitry may be defective, or the offset detection circuitry may be failing.	1) Servo PCA (track follower offtrack detection)
173	Ad	The interval between index pulses detected was too long or too short, or no pulse was detected. The servo head may not be over a zone where index pulse code exists, the index detection circuitry (e.g, the servo PROM) may be bad, or the index pulse code may be missing or incorrectly written on the disc.	1) Servo PCA (index detection circuitry, data or address lines) 2) MPU PCA (seek electronics - ROM) 3) Disc mechanism (index pulse code)
174	AE	The fault register SOK-H (speed OK) bit indicates a fault. The spindle speed is out of specification, or the speed-check circuitry is defective.	1) Spindle motor or motor control assembly 2) MPU PCA (speed-check circuitry) 3) Servo PCA (fault register)
175	AF	Servo speed-check circuitry does not detect out-of-specification spindle speed. The speed-check circuitry may be defective, or the spindle speed may not be responding to speed control commands.	1) Spindle motor control assembly 2) MPU PCA (speed-check circuitry)

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
192	C0	The DWF-L (Destructive Write Fault) bit of the fault register indicated a fault when the fault register was read. A destructive write fault may have occurred.	1) Read/write PCA 2) Servo PCA (fault register) 3) Disc mechanism (preamplifier)
193	C1	The WOT-L (Write-and-Offtrack) bit of the fault register indicated a fault when read. An offtrack may have occurred during a write.	1) Servo PCA (track-follower or fault register) 2) Disc mechanism
196	C4	No useable maintenance track could be found for the head indicated. This TERROR should always be accompanied by the head that was used to look for a good maintenance track. The drive could not successfully seek to a maintenance track or could not read any of the maintenance track sectors, using the head specified. Look at the head numbers (TERRORS "$d0_{16}$" to "$d6_{16}$") that were also logged. TERRORS logged by servo tests will prevent the read/write diagnostic from running. If all the heads are included, then the suspected hardware is most likely common to all the heads, such as the read/write PCA or the disc media. If only some of the heads were logged, most likely causes include the read/write select circuitry or the disc mechanism preamplifier(s). In addition to replacing any defective hardware, it may also be necessary to reinitialize the disc media.	1) Read/write PCA (read chain, control or select circuitry) 2) Disc media 3) Disc mechanism (preamplifier)
197	C5	When the ECC correctable sector of the maintenance track was read, no ECC correctable error was reported. May have read the wrong sector, error detection may be defective, or reads are marginal. The DMA PCA is listed as the second most suspect because any serious DMA errors would have blocked the execution of the read/write diagnostic.	1) Read/write PCA (sector counters, formatter/separator, and analog read chain) 2) DMA PCA (ECC circuitry)

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
198	C6	Write/read tests on maintenance track write test areas failed for the head(s) indicated by TERRORS "$d0_{16}$" to "$d6_{16}$". Read or write faults, or sector addressing problems. Error detection circuitry (CRC, ECC) could be reporting problems where none exist, but since this circuitry has been tested prior to the read/write diagnostic, this is less likely.	1) Read/write PCA (formatter/separator read chain, read/write control) 2) DMA PCA (ECC chip)
199	C7	The data that was read from a write test sector of the maintenance track differs from the data that should have been written to that sector. This error implies a data miscompare between a write to and a read from the same disc sector. This could mean that that the ability to write to the disc media has been lost, although reads can still be performed. Such an error would not be detected by the CRC, as long as the last write to that sector left a CRC consistent with the rest of the sector data. Normally, this error will occur with a write/read TERROR "$C6_{16}$". Look at the pattern of head failures for this error for clues to the problem.	1) Read/write PCA (write control and write path) 2) DMA PCA 3) Disc media 4) Disc mechanism (preamplifier)
201	C9	A sector compare error was detected after a disc read operation. This error is detected exactly as it would be during run-time reads. If no other read errors were reported, then this error probably points to sector counting problems rather than problems reading/writing sector headers. Three PCAs are involved in sector counting: the servo, read/write, and MPU PCAs. The servo PCA generates a byte clock, which the read/write PCA uses to produce sector pulses. The CTC (counter timer chip) on the MPU PCA counts sector pulses to determine which sector is currently addressed. At this point, the CTC and servo have passed their crucial diagnostic tests (or the read/write test would have been blocked).	1) Servo PCA (if original is not 07914-60001) 2) MPU PCA (counter timer chip) 3) Disc media 4) Disc mechanism

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER DEC	NUMBER HEX	CAUSE	SUSPECT HARDWARE
208-214	d0-d6	Whenever TERRORS "$C4_{16}$", "$C5_{16}$", "$C6_{16}$", or "$C7_{16}$" are logged, the heads on which they occurred are also logged. The head(s) reported were being used when one of the above-mentioned errors occurred. The number which follows the "d" is the number of the head involved. Refer to TERRORS $C4_{16}$- $C7_{16}$ for the hardware to suspect. The pattern of head errors should provide additional clues to the problem. Select circuitry problems may result in only one head or chip being selected. If all heads are reported, the problem is probably common to all the heads.	1) Read/write PCA (head select) 2) Disc mechanism (preamplifier)
216	d8	No sector timing pulse was detected by the MPU CTC (counter timer chip) within a reasonable period. The sector timing pulse is either not being generated by the servo and read/write PCAs, or it is not being detected by the MPU CTC.	1) Read/write PCA (check for other TERRORS) 2) Servo PCA (check for other TERRORS) 3) MPU PCA (counter timer chip)
217	d9	The DMA detected the wrong level for the Start-Of-Data (SOD-L) signal from the read/write PCA during a sector read. The read/write PCA is not generating Start-Of-Data (SOD-L) signals, or the DMA is not detecting them.	1) Read/write PCA (SOD-L circuitry) 2) DMA PCA (disc interface)
218	dA	The device was unable to read the spare table on the maintenance track. Reads from or writes to the maintenance track are failing or inconsistent, or the maintenance track spare table cannot be located.	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) Disc media 5) Disc mechanism (flex circuit)
220	dC	A logical seek failed during a verify operation. The device cannot read/write well enough to verify, or the seek failed.	1) Read/write PCA 2) DMA PCA 3) Servo PCA

Table 4-7. Internal Diagnostic Test Error Codes (continued)

NUMBER DEC	NUMBER HEX	CAUSE	SUSPECT HARDWARE
221	dd	The diagnostic error-rate test found an uncorrectable sector. Reads/writes are marginal or inconsistent, or the media is defective. Note: Early firmware revisions (prior to rev. 4-0) report this error whenever a correctable or uncorrectable data error occurs during the diagnostic error-rate test. If early firmware is installed, rerun the diagnostic twice using the external exerciser or the diagnostic self-test switch. If the error does not recur, it is safe to assume that the error was a transient correctable error and no action is necessary. If the error recurs, a problem condition may exist.	1) Read/write PCA 2) DMA PCA 3) Disc media
222	dE	Cannot read interleave table on maintenance track. Reads are not working, previous write to interleave table was bad, or cannot locate the interleave table (track or sector).	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) Disc media

Table 4-8. Run-Time Drive Error Codes

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
2	02	During a read or verify operation a read error was encountered that the ECC could not correct (uncorrectable read error). This error can be caused by either bad media or a read/write chain fault. If the media is bad, the defective area should be spared. A test of the read/write chain should determine if hardware is at fault.	1) Read/write PCA (read/write chain) 2) Disc media
3	03	During a read operation, both an uncorrectable read error and a servo system off-track error were encountered. The off-track error is the prime suspect; off-track can induce an uncorrectable read error. Perform a full servo system test. If that passes, the read/write system should be tested.	1) Servo PCA 2) Read/write PCA
4	04	During a read operation, the DMA hardware reported a data CRC error. The ECC should have detected and reported the error.	1) DMA PCA (ECC chip)
5	05	The CRC caught a read data error and the fault register indicates off-track status. The off-track condition might easily have caused the read data error. Therefore, the servo system is more suspect than the read/write chain. A full test of the servo system should be performed. If that is successful, then a read/write test should be performed.	1) Servo PCA 2) Read/write PCA
6	06	During a drive operation that was receiving data from the host, the drive received an end of transfer before the number of bytes expected to be sent to the drive were received. In some cases (receiving a command) the early EOI status is expected and is not an error. The internal diagnostic should be able to find any errors associated with the EOI status. The DMA PCA controls this status message.	1) DMA PCA

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
7	07	During a receive or a receive and write operation, the number of bytes expected from the host was received but the last byte was not tagged with EOI. Under normal conditions, this is a reporting error. If this error is associated with some possible hardware problem, the DMA PCA is suspect.	1) DMA PCA
8	08	During a receive or receive and write operation, a secondary was received while expecting data or commands. If this error is associated with a drive problem, the DMA PCA could have problems. This error is a reporting error and does not mean that there are any hardware problems. If a drive problem seems to exist, the DMA PCA is suspect.	1) DMA PCA
9	09	An incremental seek was requested that would extend beyond the last track of the device. RAM/ROM failure or a request by the host for a transfer that would extend past the end of the volume.	1) MPU PCA
13	0D	When check was made of the sector header read from the disc, the first byte (status) and the sixth byte (spare) did not contain sector numbers pointing to the same sector.	1) Read/write PCA 2) DMA PCA
14	0E	When a check was made of the header read from the disc, the first byte (status) had the most significant bit clear. This bit should always be set. The read/write PCA is suspect. A full self-test should be performed on the read/write chain.	1) Read/write PCA 2) DMA PCA
15	0F	When a check was made of the sector header read from the disc, the head number was not the one expected. The read/write chain is suspect. A full self-test on the read/write chain should be performed.	1) Read/write PCA (head select) 2) DMA PCA

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Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
16	10	When a check was made of the sector header read from the disc, the sector number was not a legal one for this device. The read/write chain is suspect. A full self-test on the read/write chain should be performed.	1) Read/write PCA 2) DMA PCA
17	11	When a check was made of the sector header read from the disc, the cylinder number was not the one expected. The read/write chain and the servo system are suspect. A full self-test should be performed on both the read/write chain and the servo system.	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) Disc media
18	12	DMA status indicates that the DMA buffer is full of data. The DMA buffer is held clear during this operation, so the DMA should not report a full buffer. The firmware holds the buffer not full on internal disc read operations (buffer reads).	1) DMA PCA
21	15	During a DMA buffer write to the disc, a rotational latency was incurred. During a buffered write, all the data is already in the DMA RAM so this error would indicate that the DMA PCA is faulty.	1) DMA PCA
23	17	The drive has been unable to access a valid copy of a system maintenance file. This could be because seeks to the various copies were unable to be completed or that the read/write chain encountered errors that caused the drive to spare out all its possible copies of the maintenance file. Note that maintenance track sparing is not related to the CS/80 spare command and proceeds without host intervention. If this error is a result of a read/write problem, the disc media will have to be reinitialized or replaced; if the error is due to a servo system failure, it should be possible to recover the maintenance track data. This error is usually accompanied by TERROR C4. A full self-test should be performed on the read/write system and then the servo system.	1) Read/write PCA 2) DMA PCA 3) Servo PCA 4) MPU PCA 5) Disc media

DERRORS

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
24	18	During an access to a system maintenance area, a maintenance file was read that had an invalid checkword. This had to be caused by a read/write failure, an uncorrectable read error, or bad media. If this error occurred during an access to the spare track table file, the spare table will be zeroed and the drive will seek to the original physical track on an access to a previously spared track. A full self-test should be performed on the read/write chain. If the read/write chain is found to be satisfactory, it must be assumed that a faulty write occurred and the disc media must be reinitialized or replaced.	1) Read/write PCA 2) DMA PCA 3) MPU PCA 4) Disc media
25	19	An access of the system maintenance area was made and all the copies of the files contained the pattern of an unitialized disc. The disc media has not been properly initialized for use.	1) The disc media needs initializing
27	1B	A seek was unable to successfully reach the target track. If error logging is enabled, this error will be preeceded by other DERROR's that elaborate on the actual nature of the failure. Note: If this error has occurred, then the heads are currently over physical cylinder zero. Since an inability to successfully read from the target track in order to verify position can also trigger this fault, both the servo system and the read/write chain are suspect. A full self-test should be performed on both the servo system and the read/write chain.	1) Servo PCA (track follower or actuator driver) 2) Read/write PCA 3) DMA PCA
28	1C	The sector interleave value could not be read from the disc. This means that the firmware will default to an interleave of one (no interleave).	None

DERRORS

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
29	1D	A recalibration operation was unable to successfully attain the normal recal position. This error will prompt a head unload operation. If fault logging is enabled, this error will be preceeded by other DERROR's that elaborate on the cause of the failure. The servo system is suspect. A full self-test should be performed on the servo system.	1) Servo PCA
30	1E	A head unload operation failed to detect that the heads were retracted and the drive was forced to perform an emergency retract (if the drive has that ability). The servo system is suspect; a full servo system test should be performed.	1) Servo PCA 2) Disc media 3) Disc mechanism
32	20	At the end of a read operation, no data errors were indicated by the hardware, but at some time since the last seek operation, the drive has gone off track. The data read is considered to be valid. If there are hardware problems associated with this error, the servo electronics should be checked out.	This error is an information error only.
33	21	During a disc read or write operation, the target sector was passed because there was either no room in the DMA buffer for the sector to be read or there was not a sectors-worth of information in the DMA buffer to be written to the disc. With RPS enabled during a write opera tion, this error could mean that the RPS window was missed. Otherwise, during a write operation, at least one sector was written to the disc and the latency was induced by a subsequent sector write.	None
34	22	The ECC electronics reported a correctable error during a read or verify. If this error is associated with hardware problems, the ECC electronics should be checked.	This error is an information error only.
35	23	The error log on the disc is full (it contains 101 entries). This may be an indication of an increasing error rate.	1) Read/write PCA 2) Disc media

DERRORS

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER DEC	NUMBER HEX	CAUSE	SUSPECT HARDWARE
36	24	The disc fault log is full (contains 65 entries). This might be an indication of degrading drive performance. A full internal diagnostic should be performed as the state of the drive is perhaps suspect. The severity of this error is directly related to the length of time since the fault log was last cleared; if the log has been cleared recently, this error may indicate a more serious drive malfunction.	None
37	25	ECC detects a correctable error in the ECC field.	This error is an information error only.
64	40	During a disc read or write operation the drive detected a hardware fault register bit set. When this fault occurs, the contents of the fault register is recorded in the status message and the fault log; this fault register status byte indicates which hardware assembly has experienced a fault. The condition causing the fault to be reported will be set high true in the fault register status byte.	1) Assembly indicated by the hardware fault register 2) MPU PCA Bit 0 = DWF-L Destructive Write Fault Bit 1 = AGC-L AGC line Bit 2 = PPF-L Possible Power Fail Bit 3 = OFT-L Off Track Bit 4 = WOT-L Write and Off Track Bit 5 = SOK-H Speed OK Bit 6 = IDENT Drive Identify (low = 7911; high = 7912/7914) Bit 7 = SPUD Spindle speed indicator pulses
65	41	Servo PCA is/was not phase-locked to the disc servo code.	1) Servo PCA 2) Disc mechanism

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
66	42	Timeout while waiting for a track crossing interrupt from the CTC.	1) MPU PCA (CTC chip) 2) Servo PCA 3) Disc mechanism
67	43	Timeout while waiting for an interrupt from the CTC. Seek failure caused by servo system fault or by MPU not generating or responding to interrupts.	1) Servo PCA 2) Disc Mechanism 3) MPU PCA (CTC chip)
68	44	Timeout while waiting for ONT-L (ontrack) at target track. This error is usually caused by a servo code defect that causes the servo PLL to come unlocked.	1) Servo PCA 2) Disc mechanism
72	48	No index pulse was detected.	1) Servo PCA 2) MPU PCA 3) Disc mechanism
76	4C	Off track bit (OFT-L) wrong at the end of a seek.	1) Servo PCA 2) Read/write PCA 3) MPU PCA
77	4D	Did not verify that a recalibrate finished on track zero. A double index pulse should have been detected but was not.	1) Servo PCA 2) Disc mechanism
78	4E	Seek aborted due to PLL out of lock or because seek blocking bit set.	1) Servo PCA 2) Disc mechanism

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
79	4F	Disc not at speed before a seek or recalibrate. Either the disc is not spinning, or the speed detection circuitry is not working.	1) Spindle motor or belt 2) Speed sensor (refer to Appendix A, Service Note no. 7911P/R-9) 3) Servo PCA 4) MPU PCA
80	50	This error is an indication that the DMA PCA may not be transferring data to the read/write PCA because the DMA is not receiving the control signals from the read/write electronics or, alternatively, there is a component failure on the DMA PCA.	1) Read write PCA 2) DMA PCA
90	5A	A spare operation retaining data was unable to seek to the target track. It is advised that a full internal diagnostic be performed before any sparing operation to ensure that ability to seek and read/write has not been lost. This error may be the reason why sparing was invoked originally.	1) Servo PCA 2) Read/write PCA
91	5B	A spare operation retaining data was unable to read all of the data from the target track. It is advised that a full internal diagnostic be performed before any sparing operation to ensure that the ability to read/write has not been lost. This error may be the reason the sparing operation was invoked originally.	1) Read/write PCA
92	5C	A sparing operation was unable to seek to either of the two closest available spare tracks to be used in that operation. A full internal diagnostic is recommended before any sparing operation. This error indicates that either a full cylinder of available spare tracks is defective or that the drive can no longer seek.	1) Servo PCA 2) Read/write PCA

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
93	5D	A sparing operation was unable to write the available spare track and successfully verify it. A full internal diagnostic is recommended before any sparing operation. This error indicates that either a full cylinder of available spare tracks was defective or that the drive can no longer read/write.	1) Read/write PCA
94	5E	An error was detected in the logical head load routine from the physical head load driver. The specific DERROR from the physical driver should be the next DERROR.	1) Servo PCA
96	60	The CTC did not decrement or reload after the time for one sector. This problem can originate anywhere along the sector timing pulse data path.	1) MPU PCA
97	61	When the firmware has decided that a non-burst disc write operation is complete, it checks the DMA as it should stop in parallel with the firmware. This error is declared if the firmware and the DMA do not agree. This error is not possible in a burst mode write since the DMA is not currently receiving data from the channel during such a write.	1) DMA (channel circuitry)
98	62	A fault bit was detected on the DMA that should never be set for this device. The DMA PCA is highly suspect and the DMA internal diagnostic should be performed.	1) DMA PCA 2) MPU PCA
99	63	The ECC experienced a data compare error during a disc write operation. The ECC chip should be thoroughly tested. Any. further disc writes before this fault is investigated are highly suspect.	1) DMA PCA (ECC chip)
100	64	An attempt was made to reset the ECC chip but the write error status bit from the ECC did not reset. Either the ECC circuitry is defective or the the MPU is having problems selecting the ECC electronics.	1) DMA PCA (ECC chip) 2) MPU PCA

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
102	66	The DMA electronics set a bit that indicates the end of a transfer before the expected termination of the transfer. Either the circuitry on the DMA PCA that looks for the end of a transfer is faulty or the ability of the MPU to sense these bits is faulty. A full internal diagnostic should be performed.	1) DMA PCA 2) MPU PCA
103	67	This error indicates that the desired sector number did not appear from the CTC within a full disc rotation. Either the CTC is not counting (perhaps due to either the CTC circuitry being in fault or the sector timing circuitry that generates the sector pulses is failing) or that has been a controller fault that caused us to be looking for an illegal sector number. A full internal diagnostic of the drive should be performed.	1) MPU PCA 2) Servo PCA (sector timing circuitry)
106	6A	A CRC error was detected during a write operation. Check the oscillator on the DMA PCA.	1) DMA PCA
107	6B	Inconsistent internal error code(s) encountered by error reporting routine.	1) MPU PCA
108	6C	While waiting for the sector counter (STP register) to reach an expected value, it was noted that the STP was counting at a faster rate than is legally possible. The STP circuitry (it is a channel of the counter-timer chip (CTC) on the MPU PCA) or the circuitry generating sector timing pulses (track follower) is bad. A full self test should be performed on the servo system and the MPU PCA.	1) MPU PCA 2) Servo PCA (STP pulse generating circuitry)
111	6F	A microdiagnostic failed that refers to the controller unit as opposed as to one of the mass storage units.	As the associated TERROR describes

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
114	72	A channel parity error has been detected by the channel interface or an illegal channel interface state (caused by receiving bus control, DMA handshake error with channel) or channel loopback failure has occurred. The error could be caused by a faulty channel or a fault in the DMA channel interface. This error could also be caused by faulty system configuration or operation.	1) DMA PCA 2) Host system channel cabling, configuration, or interface
115	73	The device received a message type which conflicted with its current state. Assuming host computer is operational, there could be a problem with the DMA hardware.	1) HP-IB cable(s) 2) DMA PCA
118	76	Channel activity has placed the device interface in an illegal state. Host software placed the device in an illegal state, or DMA hardware is improperly communicating with the interface chip (PHI).	1) DMA PCA 2) System configuration
119	77	The received length (in bytes) of an HP-IB message conflicted with the expected length. This is an internal error or possibly an interface problem.	1) HP-IB configuration 2) DMA PCA
121	79	An HP-IB message was abnormally terminated. This is an internal error or possibly an interface problem.	1) DMA PCA 2) Channel configuration
128	80	The CPU sent an illegal opcode to the device. This is an internal error or possibly a transmission problem.	1) HP-IB cables 2) DMA PCA
129	81	The CPU sent a unit or volume number which was out of bounds for this device. This is an internal error or possibly a transmission problem.	1) HP-IB cable 2) DMA PCA

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
130	82	The CPU sent a command which did not have the correct number of parameter bytes for the opcode(s) included. This is an internal error or possibly a transmission problem.	1) HP-IB cables 2) DMA PCA
136	88	An internal diagnostic failed. Look at TERROR to determine which one failed.	Determined by TERROR
177	B1	One of the first four data frames in a block had a CRC error. The TIB PCA performed a correction and the data was recovered.	None (occurs normally)
178	B2	A CRC error was detected in one of the ECC frames (frame 5 or 6).	None (occurs normally)
179	B3	Two nonadjacent frames on the tape had CRC errors. This combination of frames with CRC errors makes the block uncorrectable.	Note: No repair action is required unless this error occurs more than two times. 1) Tape media 2) Tape mechanism (if HP part no. 07908-60140)
180	B4	The frame number returned in the DMA buffer after a transfer of data from the TIB PCA to the DMA buffer is not one of the expected values.	1) TIB PCA
182	B6	When attempting to write a block of data to the tape, the target key is unreadable. When attempting to read a block of data from the tape, the target key and the first 3 frames within that block have CRC errors (the TIB PCA will attempt to retrieve the key address from the first three data frames of the block).	Note: No repair action is required unless this error occurs more than two times. 1) Tape media (cartridge) 2) TIB PCA 3) Tape mechanism

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
183	B7	During a tape verify operation where the TIB PCA is performing an "n" block verify operation, a key with a CRC error was encountered. This part of the hardware verify operation will be implemented only for products which support parallel operations.	Note: No repair action is required unless this error occurs more than two times. 1) Tape media (cartridge) 2) TIB PCA 3) Tape mechanism
184	B8	Too many blocks in a row with a key CRC error (see DERROR "$B6_{16}$"). The count is set to 20 keys in a row with CRC errors.	1) Tape media (cartridge) 2) TIB PCA 3) Tape mechanism
185	B9	This error is set after multiple attempts to seek and locate the target key. If auto sparing is on and this is a write operation, the block will be automatically spared.	Note: No repair action is required unless this error occurs more than two times. 1) Tape media (cartridge) 2) TIB PCA 3) Tape mechanism
186	BA	Eight-tenths of a second passed and the TIB PCA did not report finding a key. The TIB PCA is lost or has been "fooled" by the tape. It is usually difficult to get this error to recur.	1) Tape media
188	BC	If during a tape read and transmit operation, the host computer is slow receiving the data being sent to it, the tape may need to stop to allow the host to catch up. If the TIB PCA has data to be transferred to the DMA and a key is read on the tape, the TIB will stop the tape and report the situation to the firmware. The firmware will reposition the tape for the next data block.	None (occurs normally)

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
189	BD	This error is the same as the "BC_{16}" except that a key was read on the tape before a block of data was received from the host computer to be written to the tape. Another case where this error may appear is when a copy data from the disc to the tape is being performed and disc read retries are necessary, which forces a data overrun on the tape.	None (occurs normally)
191	BF	This error is generated when the tape encounters a jump spare on the tape since the new block is too far away from the spared block. In most cases, this error is just information for the user indicating more than one seek was necessary in order to locate the target block.	Note: No repair action is required unless this error occurs more than two times. 1) TIB PCA 2) Tape media (cartridge)
192	C0	The TIB PCA indicates that it has useful information in the completion code register. Upon reading the completion code register, the drive firmware finds the information meaningless.	1) TIB PCA 2) MPU PCA
193	C1	A command was strobed to the tape device and the tape drive did not acknowledge the command within two seconds.	1) TIB PCA 2) Tape data cable 3) Tape mechanism
194	C2	A command was strobed to the tape device and the tape drive did not acknowledge the command within two seconds.	1) TIB PCA 2) Tape data cable 3) Tape mechanism
196	C4	The command strobe procedure was called to strobe a command to the tape drive. This procedure will wait two seconds for the tape to go "not busy", in the case where the tape drive was busy before the procedure strobed the command. If the tape drive is busy and stays busy for the time limit, this error is reported.	1) TIB PCA 2) Tape data cable 3) Tape mechanism

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
197	C5	A stop command was strobed to the tape drive. The tape drive set busy status indicating it is busy stopping the tape but the busy status does not go away.	1) TIB PCA 2) Tape data cable 3) Tape mechanism
200	C8	A motion command was strobed to the tape drive. The line indicating the drive is busy is asserted by the tape drive but this line never goes false.	1) TIB PCA 2) Tape data cable 3) Tape mechanism
201	C9	A command was sent to the tape tape drive to start the tape in motion. The tape drive acknowledged the command and supposedly started the tape without any problems, but when the tape status register was read, the "at speed" bit was not set.	1) TIB PCA 2) Tape data cable 3) Tape mechanism
202	CA	Since there is no sector signal when transferring data between the TIB and DMA, the TIB toggles a flip flop for each block (256 bytes) transferred between the DMA and TIB. If the TIB does not toggle the flip flop, this error is reported.	1) TIB PCA 2) DMA PCA

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
203	CB	Status byte from tape drive has most significant bit (bit 7) set which indicates secondary status. This secondary status byte from the tape is also reported in the byte following the error byte. The bits of the secondary status byte indicate the type of failure. The suspect hardware is a function of the particular bit that is set. Bit 0 = AGC or signal-to-noise (S/N) error. Make sure the tape has not passed the tape marks at the beginning or end of the tape by manually winding the tape onto the small spool. Bit 1 = Off tape. No tape pattern was sensed on the current portion of the tape. The TIB may have erased the tape, rendering it useless. Bit 2 = Stepper motor error Bit 3 = ROM error Bit 4 = Abnormal tach signal. Even if this error is unrepeatable the tape mechanism should be changed. Bit 5 = Abnormal motor load. Ensure that the tape is not jammed or damaged. Even if this error is unrepeatable the tape mechanism should be changed. Bit 6 = illegal command Bit 7 = Will be set high to indicate the existence of a fault.	Bit 0: 1) Tape cartridge 2) Tape mechanism Bit 1: 1) TIB PCA 2) Tape cartridge Bit 2: 1) Tape mechanism Bit 3: 1) Tape mechanism Bit 4: 1) Tape mechanism Bit 5: 1) Tape cartridge 2) Tape mechanism Bit 6: 1) TIB PCA 2) Tape data cable 3) Tape mechanism
204	CC	This error will occur if, during a write operation, the TIB PCA does not pulse the four-bit down counter on the MPU PCA in 23 milliseconds. Or, if during a read operation, the TIB PCA does not indicate the completion of the operation in approximately the same time.	1) TIB PCA

DERRORS

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
205	CD	This error is set when the host attempts to perform a tape operation before the tape has completed the autoload, read the spare table and manufacturer's block on the tape. If the "not ready" status is reported even after the tape has completed the autoload and the autoload did not fail.	None
207	CF	After reseting the tape drive or after acknowledging the secondary status sent from the tape drive, the most significant bit of the tape drive status register did not return to zero after a specified time.	1) TIB PCA 2) Tape data cable 3) Tape mechanism (controller)
208	D0	During a data transfer between the TIB and DMA, the disc address counter did not increment by four.	1) TIB PCA 2) DMA PCA
209	D1	In a tape certification or a write-then-read error rate test, the firmware compares the data read with what it wrote. If they do not compare this error is reported.	1) TIB PCA 2) DMA PCA
211	D3	The firmware was waiting for the CTC to interrupt which indicates that the CTC pulsed the TIB PCA. The CTC interrupt never came.	1) MPU PCA
212	D4	When the target key is located, the TIB PCA pulses the counter timer chip on the MPU. This timer will time the delay to the initial erase and time the length of the initial erase (erase before first frame). If the CTC does not start counting after the target key is located during a write operation, this error is reported.	1) TIB PCA 2) MPU PCA
213	D5	The MPU terminated the in-progress write operation after noticing that the TIB had sequencing problems.	1) TIB PCA 2) MPU PCA (4-bit tape counter)

DERRORS

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
216	D8	The tape drive reported that a tape was in the mechanism, there was no autoload in progress and the not ready staus bit indicated that the tape was ready for use. This indicates to the firmware that the tape is ready for use. Some time later, the firmware wanted to strobe a command byte to the tape drive but the status now indicates it is not ready for use.	1) TIB PCA 2) MPU PCA 3) Tape data cable 4) Tape mechanism
217	D9	This error is used by the firmware to force the unrecoverable error bit to be set in the status field returned to the host computer. It means retries expired for a media related error.	1) Tape media 2) Tape mechanism (if HP part no. 07908-60140) Note: Check the preceeding errors in the parameter field of the status report for more information on suspect hardware.
218	DA	The firmware was unable to recover from a non-media related problem (possibly through retries). When doing an internal tape write/read test, the firmware will use this error to report that a situation encountered could not be recovered through retries or could not recover and retries are not allowed.	Check the preceeding errors in the parameter field of the status report for information on suspect hardware.
219	DB	An attempt was made to read from a tape which was never written to.	1) User inserted blank tape 2) MPU firmware
220	DC	The host attempted to access beyond the logical end of volume.	1) HP-IB cable 2) DMA PCA
222	DE	During an internal tape error rate test (ERT), the ERT log overflowed.	1) Dirty tape head 2) Tape media (cartridge) 3) Tape mechanism

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
223	DF	An attempt was made to write to a tape which is write protected.	None
228	E4	At the end of any disc read operation, the firmware will compare the header information that was read from the last sector of the disc to the expected values for that sector address. If this address is incorrect, this error is reported. This fault is an indication of a possible DMA data RAM failure.	1) DMA PCA
229	E5	At the beginning of a disc read operation, the header information from the current sector is compared to the expected sector number. If the values differ, this error is reported. There are a number of possible reasons why this situation could occur. The DMA header RAM could be failing, the CTC could be failing, the read/write electronics could have problems or the servo electronics could be dropping sector timing pulses which go to the CTC on the MPU PCA. Also, if the media has a defect which causes the servo PCA to miss a start of sector signal in the servo code this error could be reported. Note: If this error occurs during a disc-to-tape backup initiated by the SAVE switch, the MPU PCA firmware is suspect. Refer to Appendix A, Service Note no. 7911-17 for a detailed explanation of the problem.	1) DMA PCA 2) Read/write PCA 3) Servo PCA 4) MPU PCA 5) Disc mechanism 6) MPU PCA Firmware (see note)

Table 4-8. Run-Time Drive Error Codes (continued)

NUMBER		CAUSE	SUSPECT HARDWARE
DEC	HEX		
230	E6	The device was not in proper position to access the media when the CPU commanded a media access. Media not inserted, head loading or diagnostic failure, or a drive fault during real time access may have occurred.	1) Servo PCA 2) Read/write PCA

Table 4-9. W1 and W2 HP-IB to DMA Cable Information

MNEMONIC	DEFINITION	HP-IB PCA-A14 (J1 and J2)	DMA PCA-A1 or A4 (J1)
GND	Ground	1	1
ATN-L	Attention	2	2
GND	Ground	3	3
SRQ-L	Service Request	4	4
GND	Ground	5	5
IFC-L	Interface Clear	6	6
GND	Ground	7	7
NDAC-H	Not Data Accepted	8	8
GND	Ground	9	9
NRFD-H	Not Ready For Data	10	10
GND	Ground	11	11
DAV-L	Data Valid	12	12
REN-L	Remote Enable	13	13
EOI-L	End or Identify	14	14
DIO8-L	Data Input/Output Bit 8	15	15
DIO4-L	Data Input/Output Bit 4	16	16
DIO7-L	Data Input/Output Bit 7	17	17
DIO3-L	Data Input/Output Bit 3	18	18
DIO6-L	Data Input/Output Bit 6	19	19
DIO2-L	Data Input/Output Bit 2	20	20
DIO5-L	Data Input/Output Bit 5	21	21
DIO1-L	Data Input/Output Bit 1	22	22
ADR0-H	HP-IB Address Switch Bit 0	23	23
ADR1-H	HP-IB Address Switch Bit 1	24	24
ADR2-H	HP-IB Address Switch Bit 2	25	25
GND	Ground	26	26

Table 4-10. W3 Rectifier to Regulator Cable Information

MNEMONIC	DEFINITION	RECTIFIER CIRCUIT	POWER REGULATOR PCA-A13 (J600)
+11.5V	Unregulated Supply	C1 (+)	1
GND	Ground	C1 (-)	2

Table 4-11. W4 Rectifier to Regulator Cable Information

MNEMONIC	DEFINITION	RECTIFIER CIRCUIT	POWER REGULATOR PCA-A13 (J620)
-20V	Unregulated Supply	C3 (-)	1
GND	Ground	C2 (-)	2
+20V	Unregulated Supply	C2 (+)	3

Table 4-12. W5 Motor Brake to Regulator Cable Information

MNEMONIC	DEFINITION	MOTOR BRAKE	POWER REGULATOR PCA-A13 (J605)
BGND	Main Power Ground	Brake (white)	1
-20V	Unregulated Supply	Brake (white)	2

Table 4-13. W6 Power Regulator to Tape Mechanism Cable Information

MNEMONIC	DEFINITION	POWER REGULATOR PCA-A13 (J115)	TAPE MECHANISM (J3)
+12V	+12V Regulated Supply	1	1
BGND	Main Power Ground	2	2
	No Connection	3	3
+5VA	+5V Regulated Supply (high current)	4	4

Table 4-14. W7 Power Regulator to Motherboard Cable Information

MNEMONIC	DEFINITION	POWER REGULATOR PCA-A13 (J100)	MOTHERBOARD PCA-A11 (J1)
BGND	Main Power Ground	1	1
+20V	+20V Unregulated Supply	2	2
-20V	-20V Unregulated Supply	3	3
BGND	Main Power Ground	4	4
-5.2V	-5.2V Regulated Supply	5	5
-12V	-12V Regulated Supply	6	6
BGND	Main Power Ground	7	7
MRST-L	Master Reset	8	8
+6V	+6V Regulated Supply	9	9
BGND	Main Power Ground	10	10
+5 SEN	+5V Sense Line	11	11
+5VA	+5V Regulated Supply (high current)	12	12
+12VL	+12V Regulated Supply (tape)	13	13
+5VA	+5V Regulated Supply (high current)	14	14
+5VA	+5V Regulated Supply (high current)	15	15

Table 4-15. W8 Power Regulator to Motherboard Cable Information

MNEMONIC	DEFINITION	POWER REGULATOR PCA-A13 (J130)	MOTHERBOARD PCA-A11 (J3)
-4V	-4V Regulated Supply	1, 2	1, 2
GND	Ground	3, 4	3, 4
+5V	+5V Regulated Supply	5, 6	5, 6
PPF-L	Possible Power Fail	7, 8	7, 8
SENG	Sense Ground	9, 10	9, 10

Table 4-16. W9 Speed Sensor to Motherboard Cable Information

MNEMONIC	DEFINITION	SPEED SENSOR	MOTHERBOARD PCA-A11 (J2)
+5V	+5V Regulated Supply	Transducer (red)	1
	No Connection		2
SPUD	Speed Up Don't Care	Transducer (green)	3
GND	Ground	Transducer (black)	4

Table 4-17. W10 TIB to Tape Mechanism Cable Information

MNEMONIC	DEFINITION	TIB PCA-A6 (J1)	TAPE MECHANISM (J1)
CMD00	Command Bus Bit 0	1	1
CMD01	Command Bus Bit 1	2	2
GND	Ground	3, 5, 7, 9, 11, 13, 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49	3, 5, 7, 9, 11, 13 15, 17, 19, 21, 23, 25, 27, 29, 31, 33, 35, 37, 39, 41, 43, 45, 47, 49
CMD02	Command Bus Bit 2	4	4
CMD03	Command Bus Bit 3	6	6
CMD04	Command Bus Bit 4	8	8
CMD05	Command Bus Bit 5	10	10
CMD06	Command Bus Bit 6	12	12
CMD07	Command Bus Bit 7	14	14
ST07	Status Bus Bit 7	16	16
ST06	Status Bus Bit 6	18	18
ST05	Status Bus Bit 5	20	20
ST04	Status Bus Bit 4	22	22
ST03	Status Bus Bit 3	24	24
ST02	Status Bus Bit 2	26	26
ST01	Status Bus Bit 1	28	28
CSTROBE-H	Command Strobe	30	30
ST00	Status Bus Bit 0	32	32
SACK-H	Strobe Acknowledge	34	34
RESET-H	Reset (tape)	36	36
WRDATA-H	Write Data	38	38
SSTROBE-H	Status Strobe	40	40
	No Connection	42	42
SEL0-H	Select 0	44	44
CACK-H	Command Acknowledge	46	46
RDDATA	Read Data	48	48
RNWEN	Read/Not Write Enable	50	50

Table 4-18. W11 TIB to Switch Cable Information

MNEMONIC	DEFINITION	TIB PCA-A6 (J2)	SWITCH PCA-A15 (J1)
+5V	+5V Regulated Supply	1, 2	1, 2
GND	Ground	3, 4	3, 4
LAMP1	PROTECT LED Signal Line	5	5
SW1-L	Switch 1 (SAVE)	6	6
LAMP2	BUSY LED Signal Line	7	7
SW2-L	Switch 2 (RESTORE)	8	8
	No Connection	9	9
SW3-L	Switch 3 (UNLOAD)	10	10

Table 4-19. W12 Rectifier to Motherboard Cable Information

MNEMONIC	DEFINITION	RECTIFIER CIRCUIT	MOTHERBOARD PCA-A11 (J4)
RCS	Relay Control Signal	4 (Relay)	1
+5V	+5V Regulated Supply	3 (Relay)	2

Table 4-20. W13 Motor Control Assembly to Motor Cable Information

MNEMONIC	DEFINITION	ELECTRIC MOTOR ASSEMBLY (J1)	DRIVE MOTOR
Return	Motor Return	1	Motor (yellow)
Run	Motor Run Winding	2	Motor (blue)
Start	Motor Start Winding	3	Motor (red)

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD			
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11
ADR2-H	HP-IB ADDRESS SWITCH BIT 2										25														
AGC-L	AUTOMATIC GAIN CONTROL																34			15					
ATN-L	ATTENTION			2							2														
BUFS-L	DMA BUFFER SELECT						28		28																
CACK-H	COMMAND ACKNOWLEDGE													46											
CE0-L	CHIP ENABLE 0																	36			39,40				
CE1-L	CHIP ENABLE 1																	16			9,10				
CMD00	COMMAND BUS BIT 0													1											
CMD01	COMMAND BUS BIT 1													2											
CMD02	COMMAND BUS BIT 2													4											
CMD03	COMMAND BUS BIT 3													6											
CMD04	COMMAND BUS BIT 4													8											
CMD05	COMMAND BUS BIT 5													10											
CMD06	COMMAND BUS BIT 6													12											
CMD07	COMMAND BUS BIT 7													14											
COMP1	COMPENSATION 1																			30	29				

NOTES: 1. This is also a signal source when dual controller option 001 is installed.
2. Actual signal source is the Controller-In-Charge.

Table 4-21. Signal Distribution List

A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
13							22				16																		
14							24				18																		
15							26																						
16							28																						
17																													
18																													
19																													
20																													
21																													
22																													
23																													
24																													
										37, 38, 39, 40		5, 6, 7, 8																	
										33, 34, 35, 36		1, 2, 3, 4																	
		23																					23	23 NOTE 1					
		24																					24	24 NOTE 1					

Denotes Signal Source Denotes Bidirectional Signal

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SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A1
A0-H	ADDRESS BUS BIT 0						13		13							22				16						
A1-H	ADDRESS BUS BIT 1						14		14							24				18						
A2-H	ADDRESS BUS BIT 2						15		15							26										
A3-H	ADDRESS BUS BIT 3						16		16							28										
A4-H	ADDRESS BUS BIT 4						17		17																	
A5-H	ADDRESS BUS BIT 5						18		18																	
A6-H	ADDRESS BUS BIT6						19		19																	
A7-H	ADDRESS BUS BIT 7						20		20																	
A8-H	ADDRESS BUS BIT 8						21		21																	
A9-H	ADDRESS BUS BIT 9						22		22																	
A10-H	ADDRESS BUS BIT 10						23		23																	
A11-H	ADDRESS BUS BIT 11						24		24																	
ACR	ACTUATOR CURRENT RETURN																		37, 38, 39, 40		5, 6, 7, 8					
ACS	ACTUATOR CURRENT SOURCE																		33, 34, 35, 36		1, 2, 3, 4					
ADR0-H	HP-IB ADDRESS SWITCH BIT 0										23															
ADR1-H	HP-IB ADDRESS SWITCH BIT 1										24															

NOTE: 1. This is also a signal source when dual controller option 001 is installed.

Table 4-21. Signal Distribution List (continued)

	A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
			25																					25	25 NOTE 1					
									34			15																			
			2																					2	2	11 NOTE 2	11 NOTE 1 NOTE 2			
	28																													
						46																							46	
										36			39,40																	
										16			9,10																	
						1																							1	
						2																							2	
						4																							4	
						6																							6	
						8																							8	
						10																							10	
						12																							12	
						14																							14	
												30	29																	

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Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD			
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11
DIO3-L	DATA INPUT/OUTPUT BIT 3			18							18														
DIO4-L	DATA INPUT/OUTPUT BIT 4			16							16														
DIO5-L	DATA INPUT/OUTPUT BIT 5			21							21														
DIO6-L	DATA INPUT/OUTPUT BIT 6			19							19														
DIO7-L	DATA INPUT/OUTPUT BIT 7			17							17														
DIO8-L	DATA INPUT/OUTPUT BIT 8			15							15														
DMAS-L	DMA SELECT						30		30																
INTENTIONALLY BLANK																									
DOWC-L	DRAIN OFF WRITE CURRENT																39 NOTE 2								
DWF-L	DESTRUCTIVE WRITE FAULT																17			19					
DX	DIFFERENTIAL DATA X																	24			21, 22				
DY	DIFFERENTIAL DATA Y																	22			19, 20				
EC1S-L	ECC SELECT						35		41																
INTENTIONALLY BLANK																									
EOI-L	END OR IDENTIFY			14							14														
FIN-H	FORMATTER INPUT								34								31								

NOTES: 1. This is also a signal source when dual controller option 001 is installed.
2. The signal source for DOWC-L is the motherboard.

Table 4-21. Signal Distribution List (continued)

A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
											28	23																	
					30																							30	
							44																						
							40																						
3							2	3		3																			
4							4	4		4																			
5							6	5		5																			
6							8	6		6																			
7							10	7		7																			
8							12	8		8																			
9							14	9		9																			
10							16	10		10																			
		12																					12	12	6	6			
		22																					22	22	1	1			
		20																					20	20	2	2			

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Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD		
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3
COMP2	COMPENSATION 2																			28	23			
CSTROBE-H	COMMAND STROBE													30										
CTCO-H	COUNTER-TIMER CHIP OUTPUT						44									44								
CTCT-H	COUNTER-TIMER CHIP TRIGGER						41									40								
D0-H	DATA BUS BIT 0						3		3							2	3		3					
D1-H	DATA BUS BIT 1						4		4							4	4		4					
D2-H	DATA BUS BIT 2						5		5							6	5		5					
D3-H	DATA BUS BIT 3						6		6							8	6		6					
D4-H	DATA BUS BIT 4						7		7							10	7		7					
D5-H	DATA BUS BIT 5						8		8							12	8		8					
D6-H	DATA BUS BIT 6						9		9							14	9		9					
D7-H	DATA BUS BIT 7						10		10							16	10		10					
DAV-L	DATA VALID			12 NOTE 1							12													
INTENTIONALLY BLANK																								
DIO1-L	DATA INPUT/OUTPUT BIT 1			22							22													
DIO2-L	DATA INPUT/OUTPUT BIT 2			20							20													

NOTES: 1. This is also a signal source when dual controller option 001 is installed.

Table 4-21. Signal Distribution List (continued)

A4 DMA		A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
	18																					18	18	3	3			
	16																					16	16	4	4			
	21																					21	21	13	13			
	19																					19	19	14	14			
	17																					17	17	15	15			
	15																					15	15	16	16			
							39 NOTE 2																					
							17			19																		
								24			21, 22																	
								22			19, 20																	
	14																					14	14	5	5			
							31																					

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Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD			
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11
LA7-H	LINKED ADDRESS BUS BIT 7	20			20																				
LA8-H	LINKED ADDRESS BUS BIT 8	21			21																				
LA9-H	LINKED ADDRESS BIT 9	22			22																				
LA10-H	LINKED ADDRESS BUS BIT 10	23			23																				
LA11-H	LINKED ADDRESS BUS BIT 11	24			24																				
LAMP1	PROTECT LED SIGNAL LINE														5										
LAMP2	BUSY LED SIGNAL LINE														7										
LBUFS-L	LINKED DMA BUFFER SELECT	28			28																				
LCTCO-H	LINKED COUNTER-TIMER CHIP OUTPUT				44							44				43									
LCTCT-H	LINKED COUNTER-TIMER CHIP TRIGGER				41							41				39									
LD0-H	LINKED DATA BUS BIT 0	3			3							3				1									
LD1-H	LINKED DATA BUS BIT 1	4			4							4				3									
LD2-H	LINKED DATA BUS BIT 2	5			5							5				5									
LD3-H	LINKED DATA BUS BIT 3	6			6							6				7									
LD4-H	LINKED DATA BUS BIT 4	7			7							7				9									
LD5-H	LINKED DATA BUS BIT 5	8			8							8				11									

Table 4-21. Signal Distribution List (continued)

A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
								40 NOTE 1																					
38								23																					
								13																					
									32			31, 32																	
									17			15, 16																	
											22	17, 18																	
										30																			
		6																					6	6	9 NOTE 4	9 NOTE 2 NOTE 4			
32																													
			13				21 NOTE 3																						
			14				23 NOTE 3																						
			15				25 NOTE 3																						
			16				27 NOTE 3																						

7912-42(5)A

Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD		
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3
FIND-L	FOURTEEN IDENTIFY																40 NOTE 1							
FOUT-H	FORMATTER/ SEPARATOR OUTPUT								38								23							
FSS-L	FORMATTER/ SEPARATOR SELECT						34										13							
HS1	HEAD SELECT 1																	32			31, 32			
HS2	HEAD SELECT 2																	17			15, 16			
IDENT	IDENTIFICATION LINE																			22	17, 18			
IDX-L	INDEX							14											30					
IFC-L	INTERFACE CLEAR			6							6													
IOS-L	DMA PHI SELECT						32		32															
LA0-H	LINKED ADDRESS BUS BIT 0	13			13							13				21 NOTE 3								
LA1-H	LINKED ADDRESS BUS BIT 1	14			14							14				23 NOTE 3								
LA2-H	LINKED ADDRESS BUS BIT 2	15			15							15				25 NOTE 3								
LA3-H	LINKED ADDRESS BUS BIT 3	16			16							16				27 NOTE 3								
LA4-H	LINKED ADDRESS BUS BIT 4	17			17																			
LA5-H	LINKED ADDRESS BUS BIT 5	18			18																			
LA6-H	LINKED ADDRESS BUS BIT 6	19			19																			

NOTES: 1. The signal source for FIND-L is the motherboard.
2. This is also a signal source when dual controller option 001 is installed.
3. This is the source signal when the tape unit is selected to be active in standard configurations
4. Actual signal source is the Controller-In-Charge.

Table 4-21. Signal Distribution List (continued)

A4 DMA		A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
					5																					5		
					7																					7		
		44				43																						
		41				39																						
		3				1																						
		4				3																						
		5				5																						
		6				7																						
		7				9																						
		8				11																						

7912-42(6)A

Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD			
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11
OFT-L	OFF TRACK																21			11					
ONT-L	ON TRACK							17									30			12					
ΦINT-L	PHI INTERRUPT LINE							5		5															
PG	DATA PREAMP GROUND																	21,23			11,12, 24,37, 38				
PPF-L	POSSIBLE POWER FAIL																			9				7,8	
RCS	RELAY CONTROL SIGNAL																27								
RDDATA	READ DATA													48											
RD-L	READ						11		11							18	11		11						
REN-L	REMOTE ENABLE			13							13														
RESET-H	RESET (Tape)													36											
RESS-L	RESET SELECT						27																		
RNWEN	READ/NOT WRITE ENABLE													50											
RWC-L	READ/WRITE CLOCK								42							42 NOTE 1 NOTE 2	18								
RWS-L	READ/WRITE SELECT						31										14								
SACK-H	STROBE ACKNOWLEDGE													34											
SCK	SERVO CLOCK																28		27						

NOTES: 1. This is also a signal source when dual controller option 001 is installed.
2. This is the signal source when the tape unit is selected to be active in standard configurations.

Table 4-21. Signal Distribution List (continued)

A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
			9				13																						
			10				15																						
			37				35																						
			35				31 NOTE 1																						
			11				17 NOTE 1																						
			42				41																						
			36				33																						
			39				37																						
			33				29 NOTE 1																						
			12				19 NOTE 1																						
	16		32					32		32			8				8												
		8																					8	8	8	8			
		10																					10	10	7	7			

7912-42(7)A

Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD		
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3
LD6-H	LINKED DATA BUS BIT 6	9			9							9				13								
LD7-H	LINKED DATA BUS BIT 7	10			10							10				15								
LDMAS-L	LINKED DMA SELECT	30			30																			
LDIN-H	LINKED DMA INPUT	37										37				35								
LDOUT-H	LINKED DMA OUTPUT	33										35				31 NOTE 1								
LIOS-L	LINKED DMA PHI SELECT	32			32																			
LΦINT-L	LINKED PHI INTERRUPT LINE		5			5																		
LRD-L	LINKED READ	11			11							11				17 NOTE 1								
LRWC-L	LINKED READ/WRITE CLOCK	42										42				41								
LSOD-L	LINKED START OF DATA		20									36				33								
LSOS-L	LINKED START OF SECTOR		15									39				37								
LTIBS-L	LINKED TIB SELECT				33							33				29 NOTE 1								
LWR-L	LINKED WRITE	12			12							12				19 NOTE 1								
MRST-L	MASTER RESET		16			16		16		16		32					32		32			8		
NDAC-L	NOT DATA ACCEPTED			8							8													
NRFD-L	NOT READY FOR DATA			10							10													

NOTE: 1. This is the signal source when the tape unit is selected to be active in standard configurations.

Table 4-21. Signal Distribution List (continued)

A4 DMA		A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
							21			11																		
							30			12																		
5																												
								21,23			11,12, 24,37, 38																	
										9				7,8				7,8										
							27																					
				48																							48	
						18	11		11																			
	13																					13	13	17	17			
				36																							36	
				50																							50	
						42 NOTE 1 NOTE 2	18																						
							14																					
				34																							34	
							28		27																			

7912-42(8)A

Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD			
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11
ST04	STATUS BUS BIT 4													22											
ST05	STATUS BUS BIT 5													20											
ST06	STATUS BUS BIT 6													18											
ST07	STATUS BUS BIT 7													16											
STP-L	SECTOR TIMING PULSE							41									29		29						
SW1-L	SWITCH 1 (SAVE)														6										
SW2-L	SWITCH 2 (RESTORE)														8										
SW3-L	SWITCH 3 (UNLOAD)														10										
TIBS-L	TIB SELECT						33									30									
TKX-L	TRACK CROSSING						40												31						
US	UNSAFE CURRENT																	30			27,28				
WC	WRITE CURRENT																	27,28			25,26				
WOT-L	WRITE AND OFF TRACK																19			13					
WRDATA	WRITE DATA													38											
WR-L	WRITE						12		12							20	12		12						
WS0	WRITE SELECT 0																	34			35,36				
WS1	WRITE SELECT 1																	18			13,14				

Table 4-21. Signal Distribution List (continued)

A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
								24			20																		
					44																							44	
											34																		
	20						34 NOTE 1	36																					
											21																		
	15						38 NOTE 1	35																					
											44	45,46																	
											40	43,44																	
											42	41,42																	
											17			2															
		4																					4	4	10	10			
					40																							40	
					32																							32	
					28																							28	
					26																							26	
					24																							24	

7912-42(9)A

Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD		
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3
SEK-H	SEEK																24			20				
SEL0-H	SELECT 0													44										
SERS-L	SERVO SELECT						29													34				
SOD-L	START OF DATA									20						34 NOTE 1	36							
SOK-H	SPEED OK							42												21				
SOS-L	START OF SECTOR									15						38 NOTE 1	35							
SP1	SERVO PREAMP LINE 1																			44	45,46			
SP2	SERVO PREAMP LINE 2																			40	43,44			
SPG	SERVO PREAMP GROUND																			42	41,42			
SPUD	SPEED UP DON'T CARE																			17			2	
SRQ-L	SERVICE REQUEST			4 NOTE 2							4													
SSTROBE-H	STATUS STROBE													40										
ST00	STATUS BUS BIT 0													32										
ST01	STATUS BUS BIT 1													28										
ST02	STATUS BUS BIT 2													26										
ST03	STATUS BUS BIT 3													24										

NOTE: 1. This is the signal source when the tape unit is selected to be active in standard configurations.

NOTE: 2. This is also a signal source when dual controller option 001 is installed.

Table 4-21. Signal Distribution List (continued)

A4 DMA		A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
				22																							22	
				20																							20	
				18																							18	
				16																							16	
							29		29																			
					6																					6		
					8																					8		
					10																					10		
						30																						
									31																			
								30			27,28																	
								27,28			25,26																	
							19			13																		
				38																							38	
						20	12		12																			
								34			35,36																	
								18			13,14																	

7912-42(10)A

Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC OR VOLTAGE	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD			
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A1
MRST-L	MASTER RESET		16			16		16		16		32					32		32			8			
PG	PREAMP GROUND																	21, 23			11,12, 24,37, 38				
PPF-L	POSSIBLE POWER FAIL																			9				7, 8	
SENG	SENSE GROUND																							9, 10	
SGND	SERVO GROUND																		17, 18, 19, 20			10			
SPG	SERVO PREAMP GROUND																			42	41, 42				

Table 4-22. Power Distribution List

A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
								41,42				33,34			1,2				1,2										
									5,6		5,6		5				5												
			49,50					49,50		49,50			6				6												
47,48	3,4		47,48	3,4	1,2			47,48	3,4				11,12, 14,15	1	5,6	2	11										1,2		
47,48	3,4		47,48	3,4	1,2			47,48	3,4	47,48	3,4		11,12, 14,15	1	5,6	2			5,6								1,2		
47,48	3,4		47,48	3,4	1,2			47,48	3,4	47,48	3,4		11,12, 14,15	1	5,6	2	12,14, 15	4									1,2		4
								43,44		43,44		30	9				9												
																		1											1
	1,2			1,2					1,2		1,2	47,48	13				13												
										13,14, 15,16							3				2	1							
																				2									
										21,22, 23,24							2					3								
									7,8, 19,20, 25,26, 49,50		7,8, 25,26, 49,50								3,4, 9,10										
														4	3,4		1,4, 7,10	2	3,4, 9,10	1	1	2							2
1,2, 25,26, 31,35, 36,39, 40,44, 45,46	7,8, 18,21, 22,25, 26,49, 50		1,2, 25,26, 45,46	7,8, 25,26, 49,50	NOTE 1	3,4		1,2, 20,25, 26,39, 40,45, 46 NOTE 2		1,2, 25,26, 45,46,		49,50	1,4, 7,10	4	3,4		1,4, 7,10		3,4, 9,10										

7912-43(1)A

Denotes Signal Source Denotes Bidirectional Signal

SIGNAL MNEMONIC	DEFINITION	A1 TIBDMA			A2 TIBUPROC		A3 UPROC		A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD		
		XA1P1	XA1P2	A1J1	XA2P1	XA2P2	XA3P1	XA3P2	XA4P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3
-4V	REGULATED																41,42				33,34			1,2
-5.2V	REGULATED																	5,6		5,6		5		
-12V	REGULATED				49,50		49,50					49,50					49,50		49,50			6		
+5SEN	REGULATED	47,48	3,4		47,48	3,4	47,48	3,4	47,48	3,4		47,48	3,4	1,2			47,48	3,4				11,12, 14,15	1	5,6
+5V	REGULATED	47,48	3,4		47,48	3,4	47,48	3,4	47,48	3,4		47,48	3,4	1,2			47,48	3,4	47,48	3,4		11,12, 14,15	1	5,6
+5VA	REGULATED	47,48	3,4		47,48	3,4	47,48	3,4	47,48	3,4		47,48	3,4	1,2			47,48	3,4	47,48	3,4		11,12, 14,15	1	5,6
+6V	REGULATED																43,44		43,44		30	9		
+12V	REGULATED																							
+12VL	REGULATED		1,2			1,2		1,2		1,2			1,2					1,2		1,2	47,48	13		
-20V	UNREGULATED																		13,14, 15,16					
+11.5V	UNREGULATED																							
+20V	UNREGULATED																		21,22, 23,24					
AGND	SENSE GROUND																	7,8, 19,20, 25,26, 49,50		7,8, 25,26, 49,50				
BGND	MAIN POWER GROUND																					4		3,4
GND	GROUND	1,2, 25,26, 31,35, 36,39, 40,44, 45,46	7,8, 18,21, 22,25, 26,49, 50		1,2, 25,26, 45,46	7,8, 25,26, 49,50	1,2, 25,26, 45,46	7,8, 25,26, 49,50	1,2, 25,26, 31,35, 36,39, 40,44, 45,46	7,8, 18,21, 22,25, 26,49, 50		1,2, 25,26, 45,46	7,8, 25,26, 49,50	NOTE 1	3,4		1,2, 20,25, 26,39, 40,45, 46 NOTE 2		1,2, 25,26, 45,46,		49,50	1,4, 7,10	4	3,4

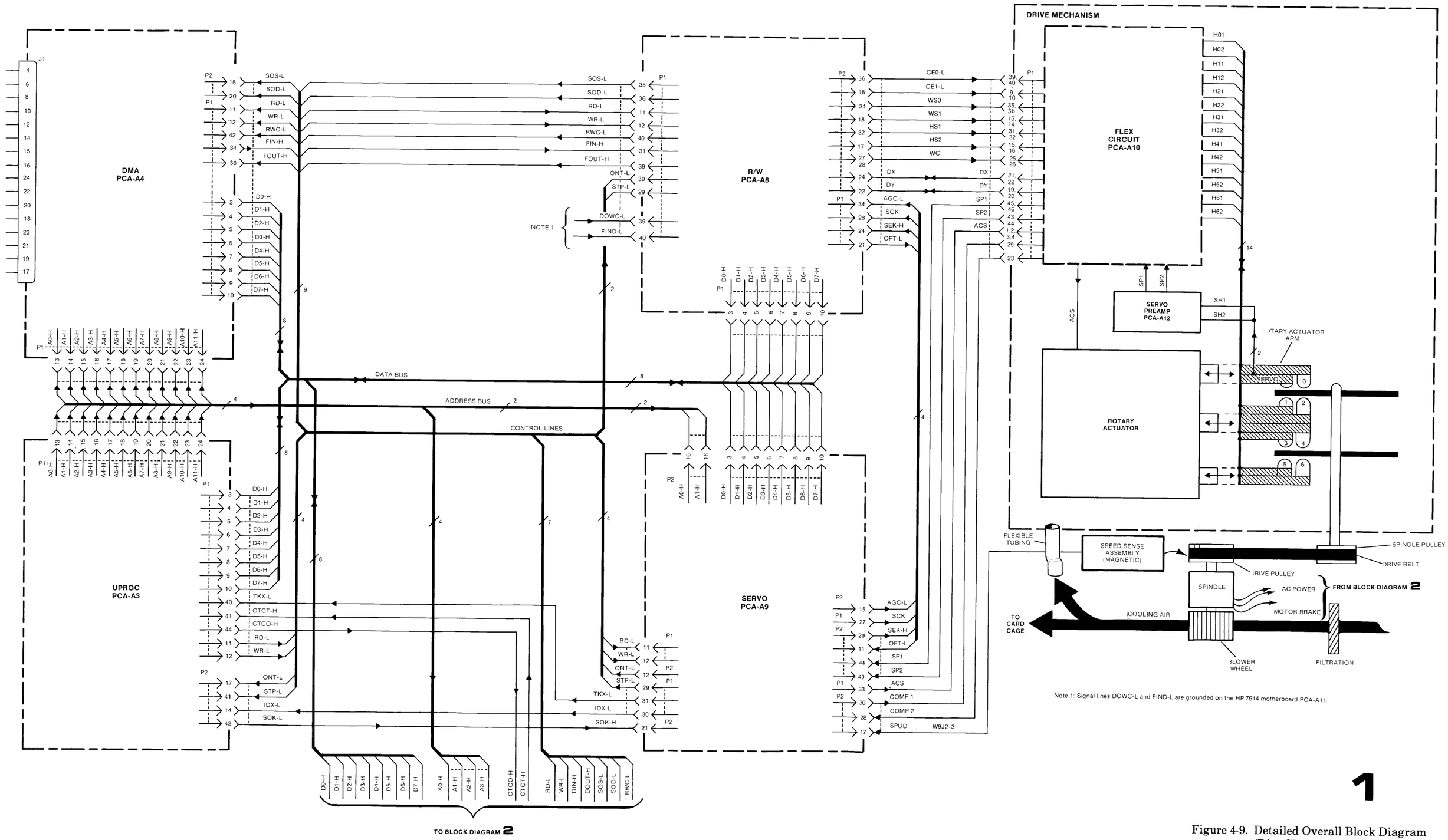
NOTES: 1. Odd numbered pins 3 through 39.
2. Pins 39 and 40 are grounded only in the HP 7914.

Table 4-22. Power Distribution List (continued)

A4 DMA			A6 TIB				A7 JMP	A8 R/W		A9 SERVO		A10 FLEX	A11 MOTHERBOARD				A13 REGULATOR						A14 HP-IB				A15 SWITCH	TAPE MECHANISM	
P1	XA4P2	A4J1	XA6P1	XA6P2	A6J1	A6J2	XA7P1	XA8P1	XA8P2	XA9P1	XA9P2	XA10P1	A11J1	A11J2	A11J3	A11J4	A13J100	A13J115	A13J130	A13J600	A13J605	A13J620	A14J1	A14J2	A14J3	A14J4	A15J1	J1	J3
	16		32					32		32			8				8												
									21, 23			11,12, 24,37, 38																	
											9				7, 8				7, 8										
															9, 10				9, 10										
										17, 18, 19, 20			10				1, 4, 7, 10												
											42	41, 42																	

7912-43(2)A

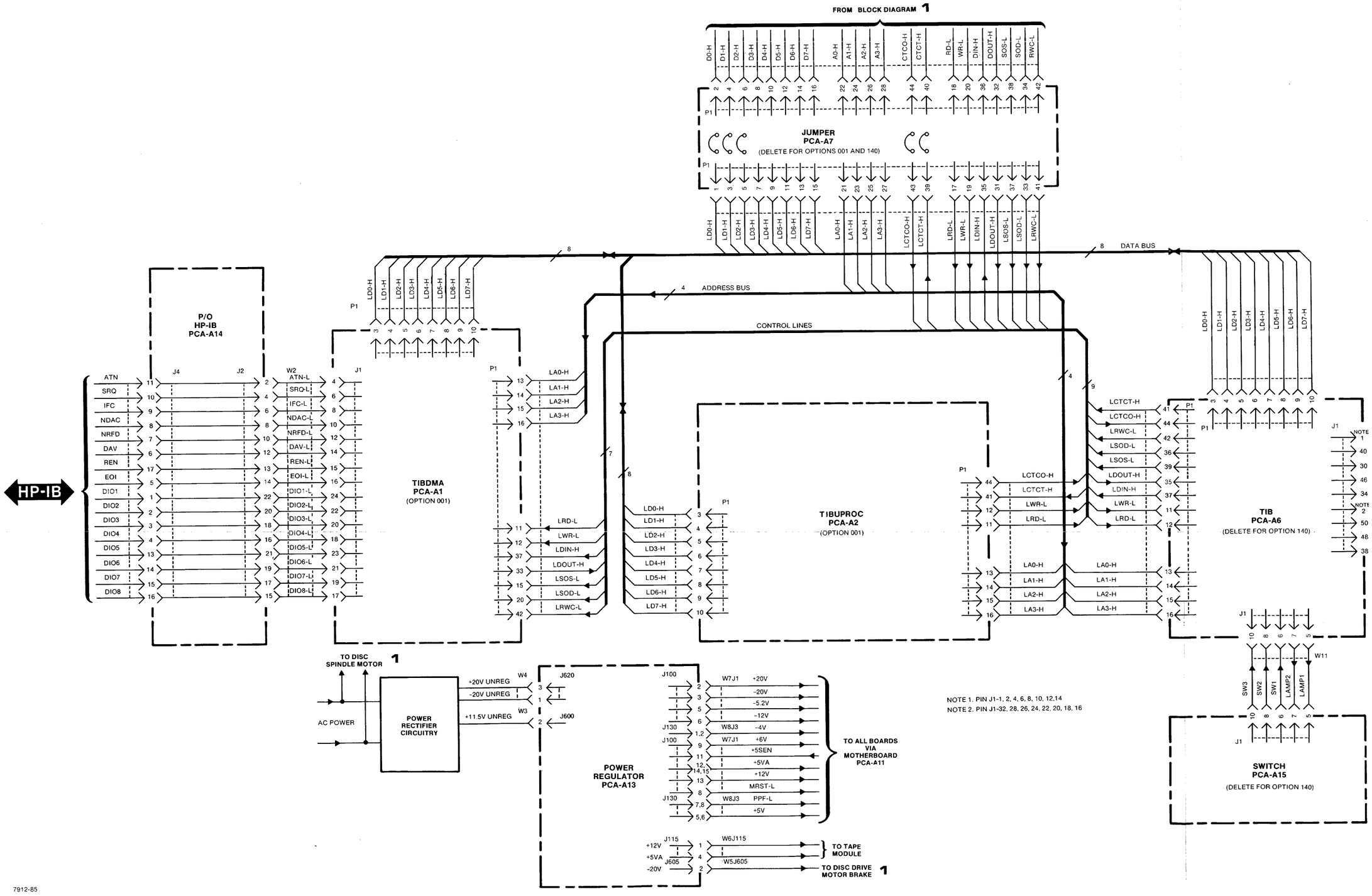
Denotes Signal Source   Denotes Bidirectional Signal

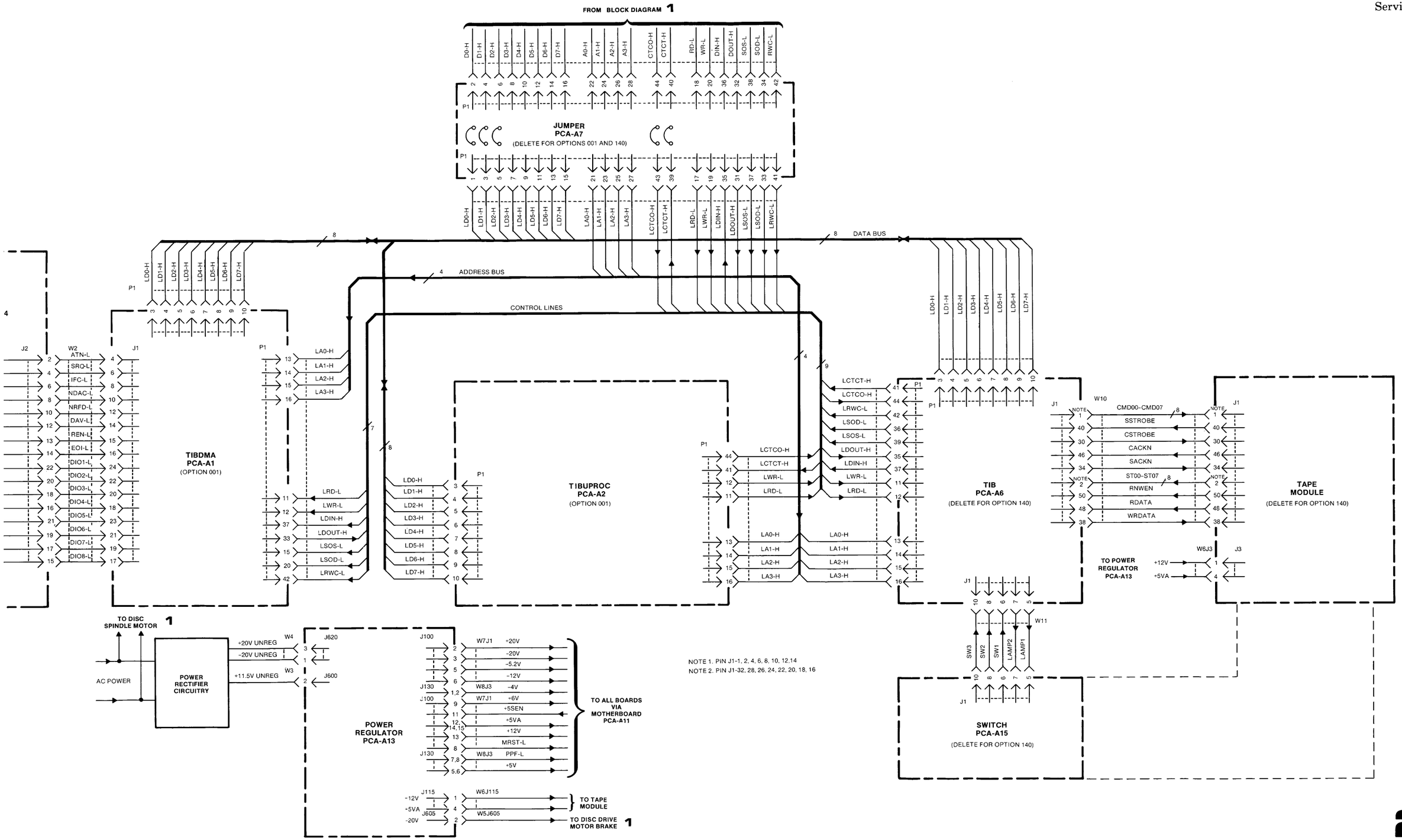


Note 1: Signal lines DOWC-L and FIND-L are grounded on the HP 7914 motherboard PCA-A11.

1

Figure 4-9. Detailed Overall Block Diagram (Disc Circuits)


FROM BLOCK DIAGRAM 1
D0-H
D1-H
D2-H
D3-H
D4-H
D5-H
D6-H
D7-H
A0-H
A1-H
A2-H
A3-H
CTCO-H
CTCT-H
RD-L
WR-L
DIN-H
DOUT-H
SOS-L
SOD-L
RWC-L
P1
JUMPER
PCA-A7
(DELETE FOR OPTIONS 001 AND 140)
LD0-H
LD1-H
LD2-H
LD3-H
LD4-H
LD5-H
LD6-H
LD7-H
LA0-H
LA1-H
LA2-H
LA3-H
LCTCO-H
LCTCT-H
LRD-L
LWR-L
LDIN-H
LDOUT-H
LSOS-L
LSOD-L
LRWC-L
8
DATA BUS
4
ADDRESS BUS
CONTROL LINES
P/O
HP-IB
PCA-A14
HP-IB
ATN
SRQ
IFC
NDAC
NRFD
DAV
REN
EOI
DIO1
DIO2
DIO3
DIO4
DIO5
DIO6
DIO7
DIO8
J4
J2
W2
J1
ATN-L
SRQ-L
IFC-L
NDAC-L
NRFD-L
DAV-L
REN-L
EOI-L
DIO1-L
DIO2-L
DIO3-L
DIO4-L
DIO5-L
DIO6-L
DIO7-L
DIO8-L
TIBDMA
PCA-A1
(OPTION 001)
TIBUPROC
PCA-A2
(OPTION 001)
TIB
PCA-A6
(DELETE FOR OPTION 140)
SWITCH
PCA-A15
(DELETE FOR OPTION 140)
SW3
SW2
SW1
LAMP2
LAMP1
W11
NOTE 1. PIN J1-1, 2, 4, 6, 8, 10, 12,14
NOTE 2. PIN J1-32, 28, 26, 24, 22, 20, 18, 16
TO DISC
SPINDLE MOTOR
1
AC POWER
POWER
RECTIFIER
CIRCUITRY
+20V UNREG
-20V UNREG
+11.5V UNREG
W4
W3
J620
J600
POWER
REGULATOR
PCA-A13
W7J1 +20V
-20V
-5.2V
-12V
W8J3 -4V
W7J1 +6V
+5SEN
+5VA
+12V
MRST-L
W8J3 PPF-L
+5V
TO ALL BOARDS
VIA
MOTHERBOARD
PCA-A11
+12V
+5VA
-20V
J115
J605
W6J115
W5J605
TO TAPE
MODULE
TO DISC DRIVE
MOTOR BRAKE
1
7912-85



NOTE 1. PIN J1-1, 2, 4, 6, 8, 10, 12,14
NOTE 2. PIN J1-32, 28, 26, 24, 22, 20, 18, 16

Figure 4-10. Detailed Overall Block Diagram (Tape Circuits)

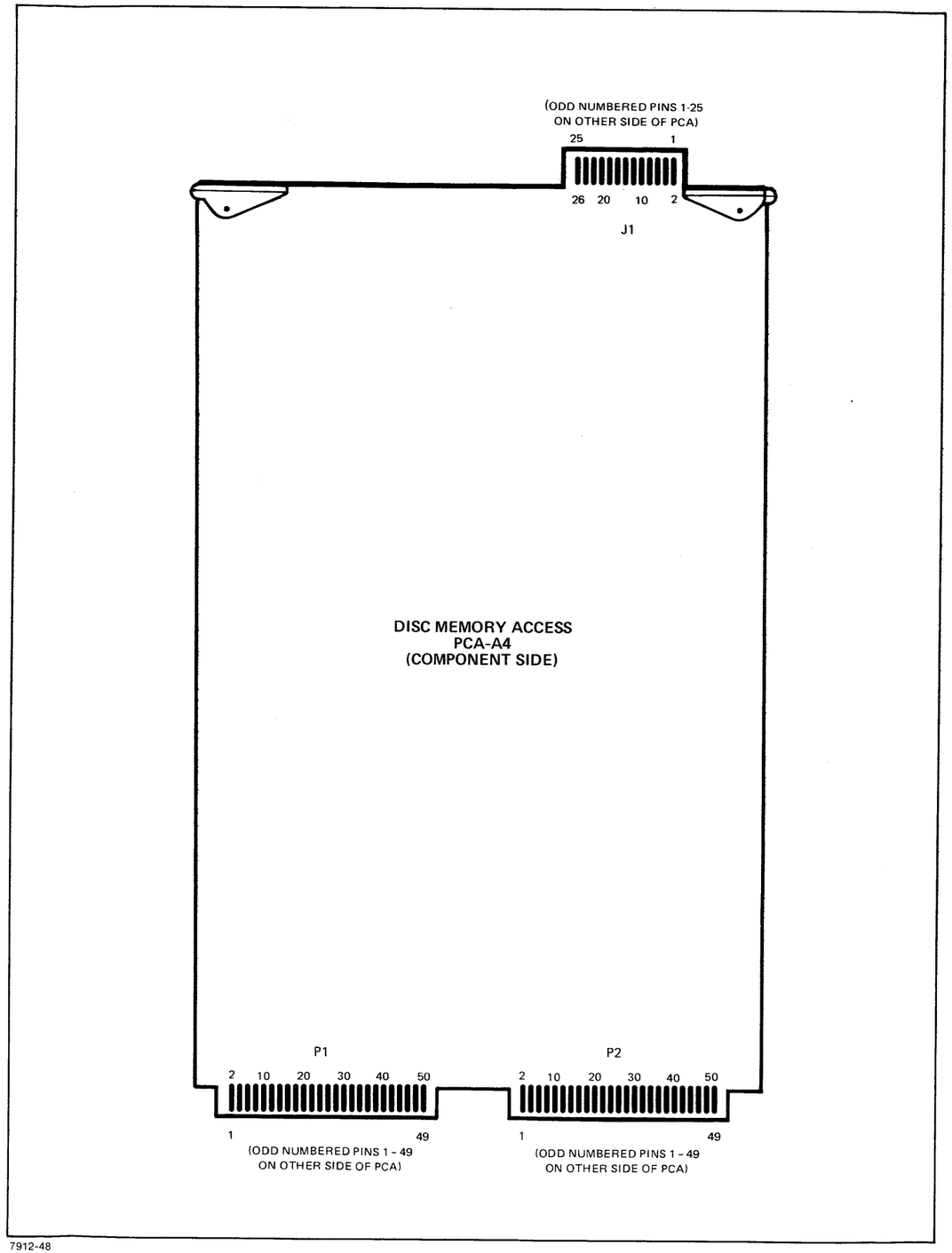


Figure 4-11. Disc Memory Access PCA-A4 Layout

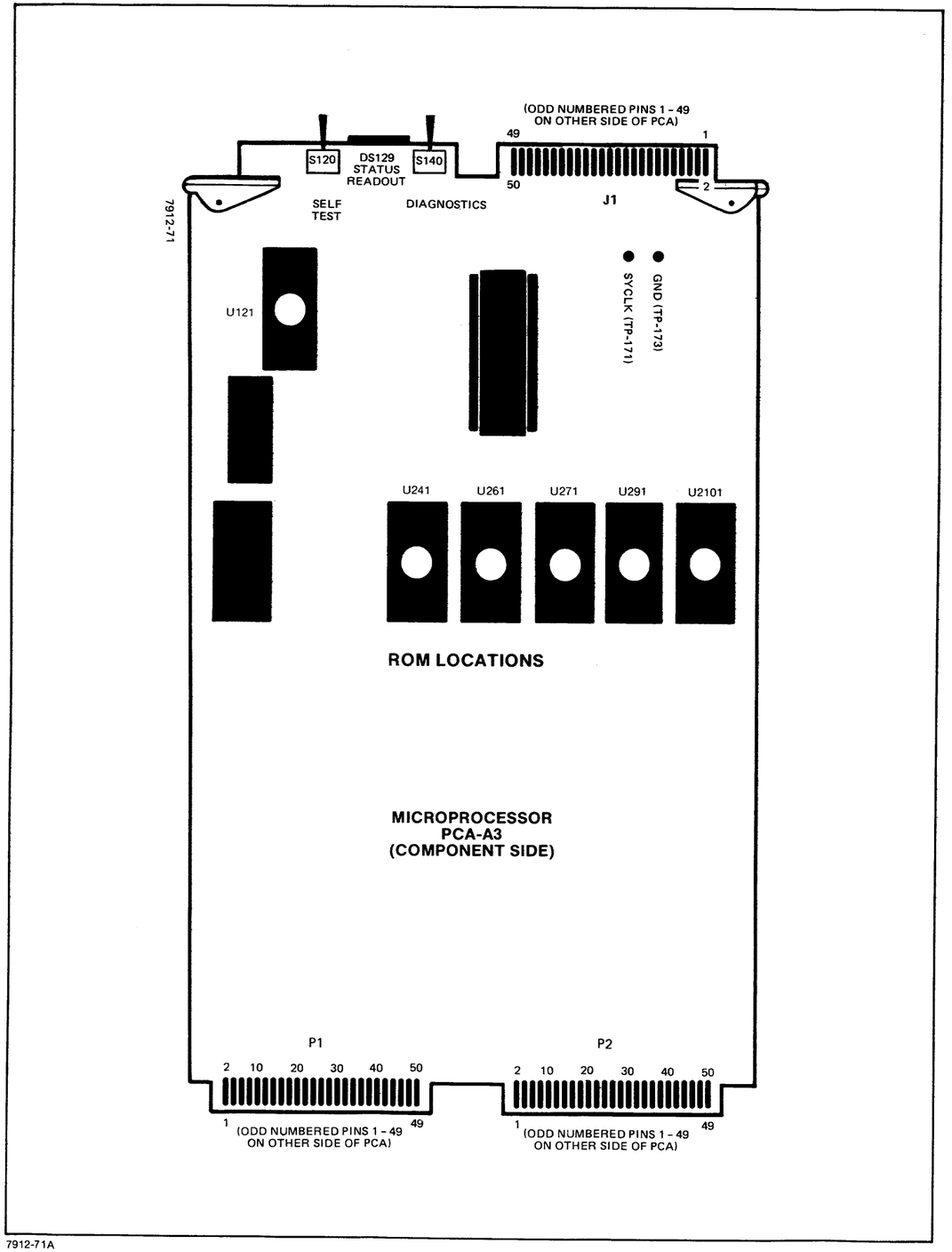
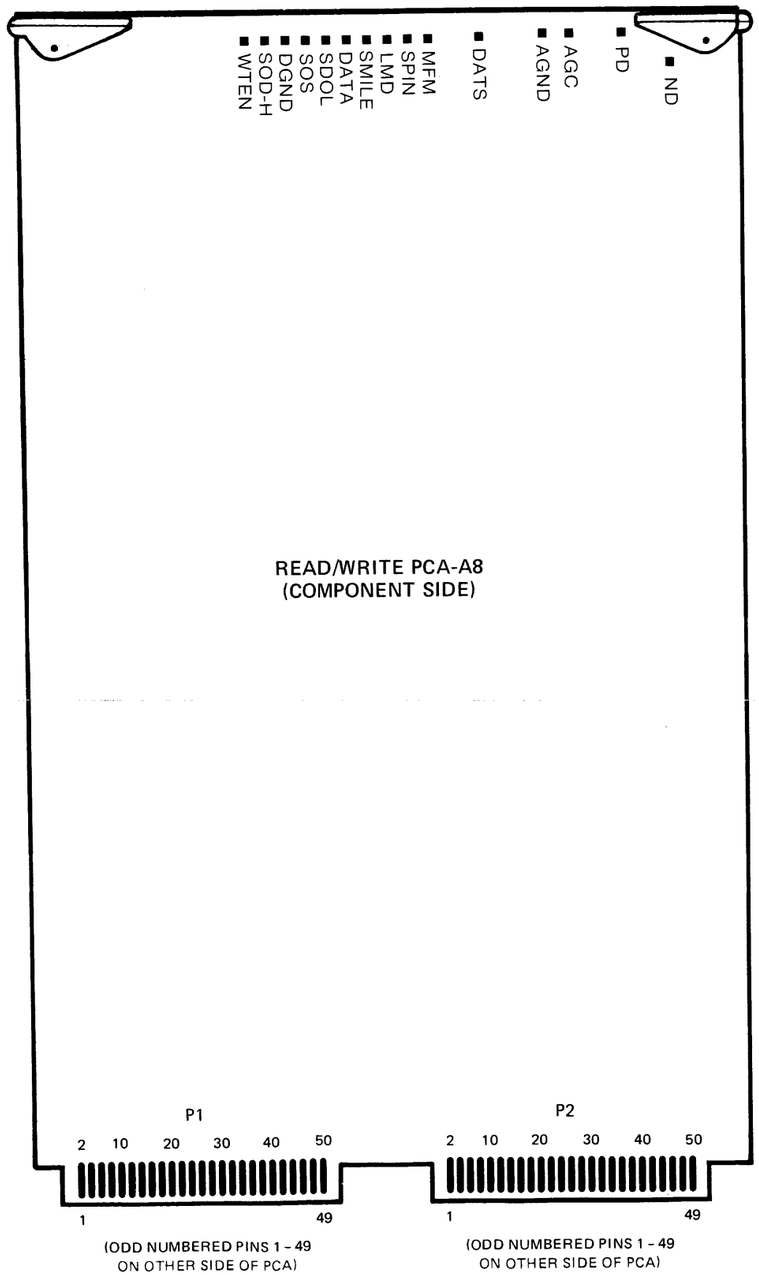
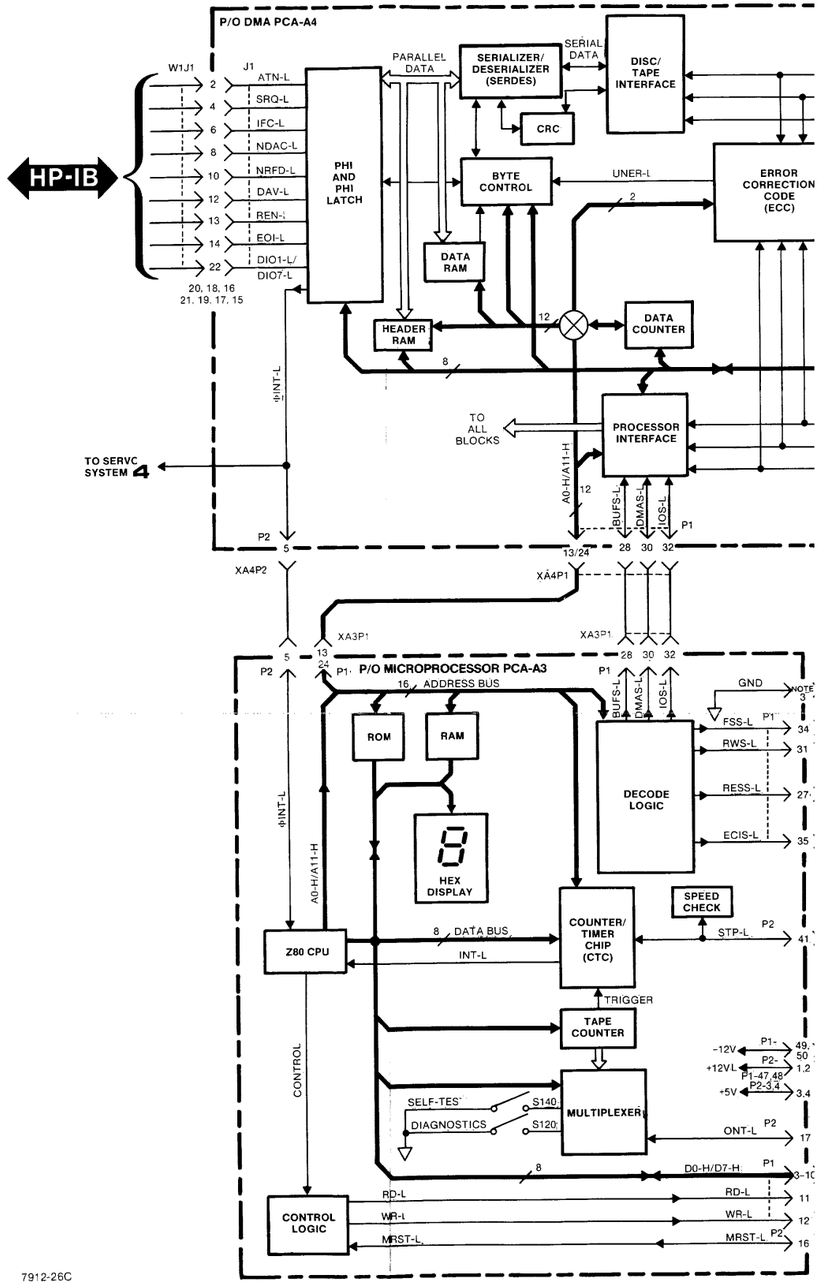


Figure 4-12. Microprocessor PCA-A3 Layout

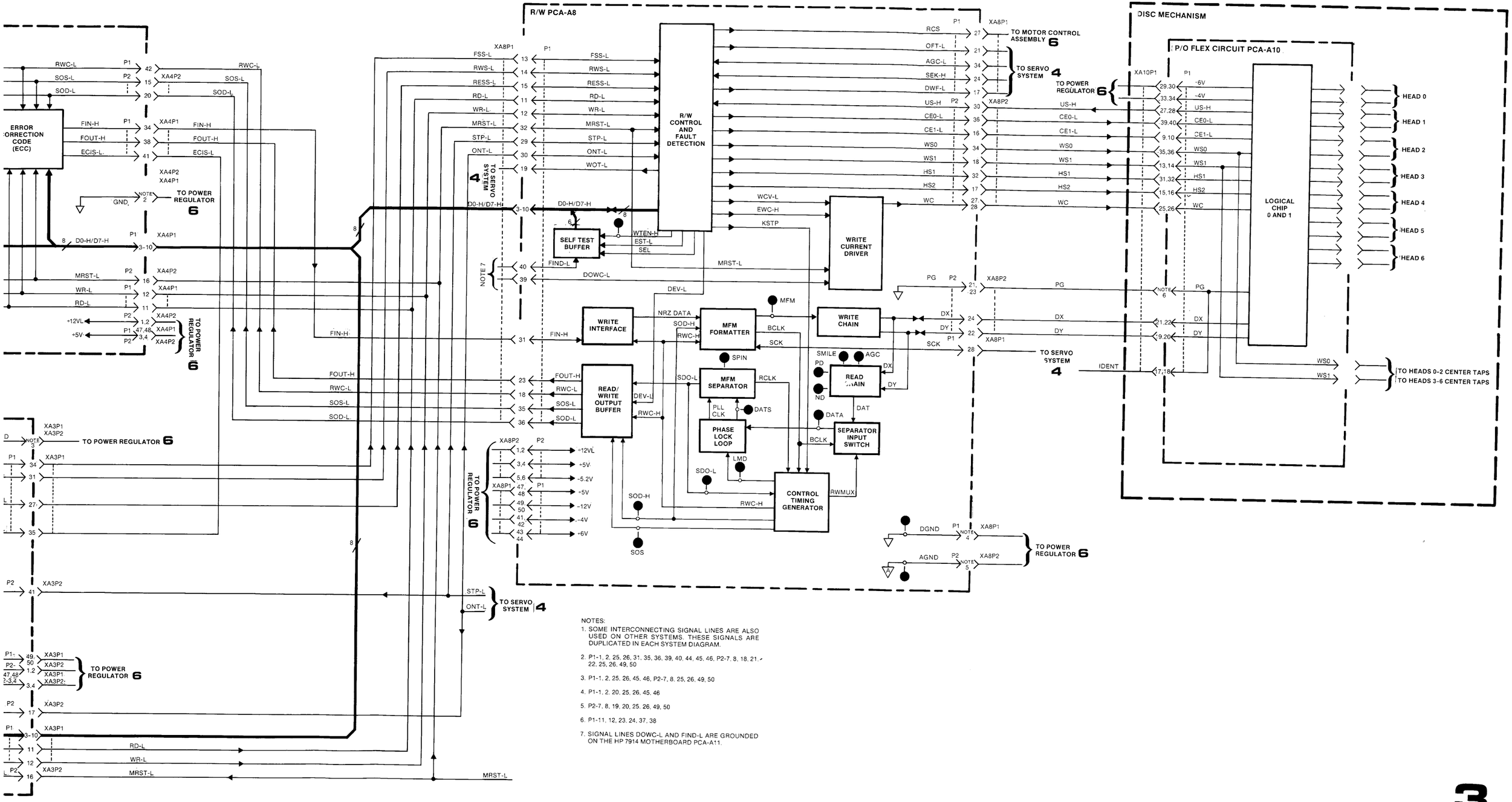


7912-49B

Figure 4-13. Read/Write PCA-A8 Layout

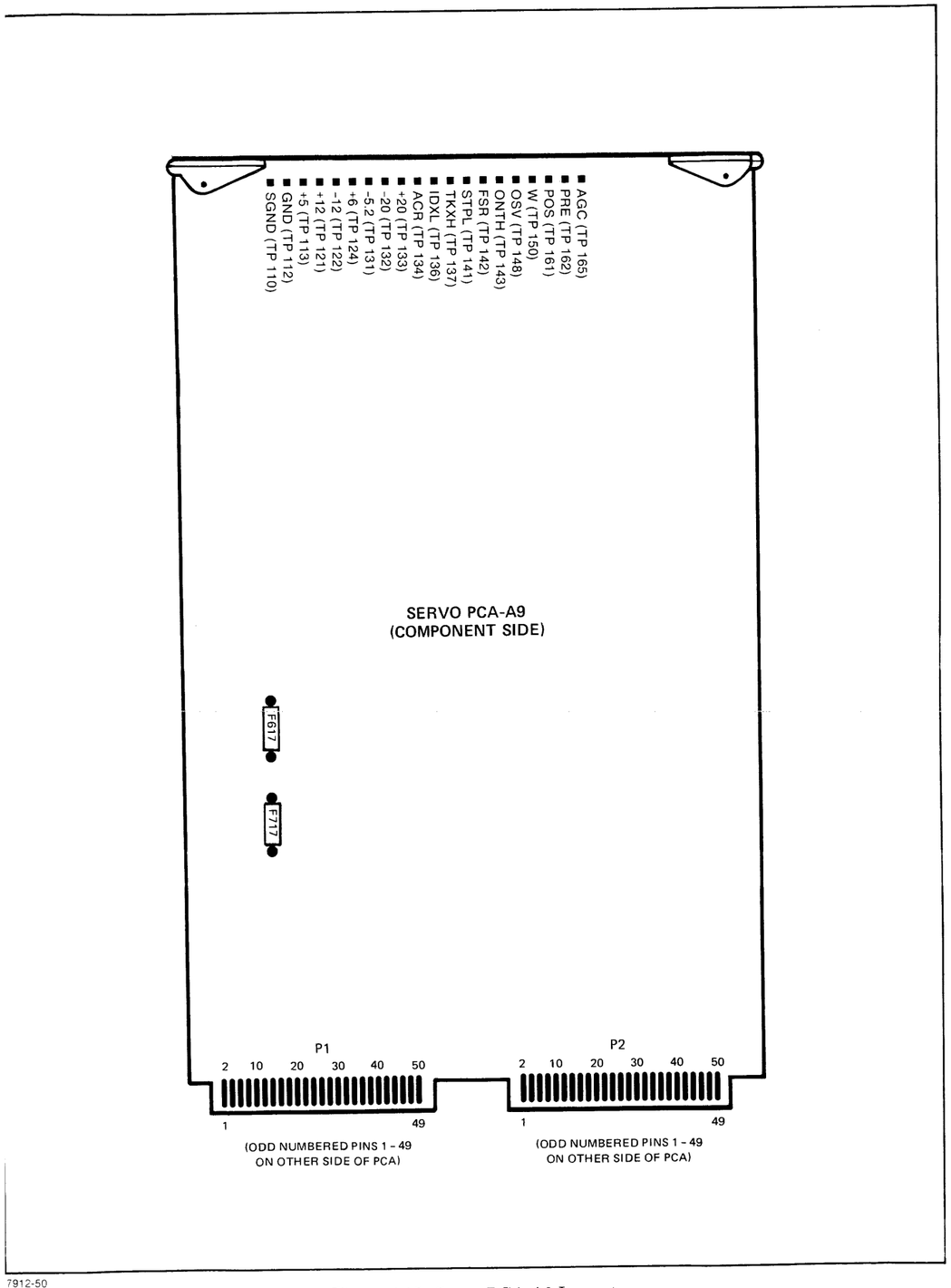


7912-26C



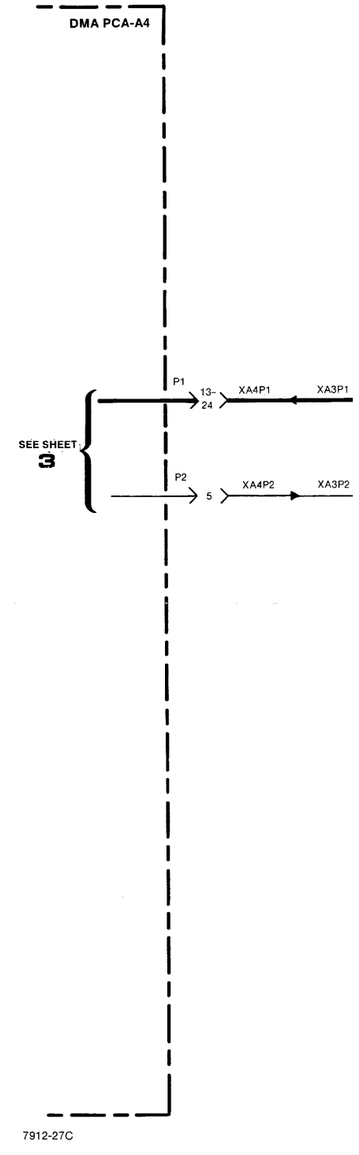
NOTES:
1. SOME INTERCONNECTING SIGNAL LINES ARE ALSO USED ON OTHER SYSTEMS. THESE SIGNALS ARE DUPLICATED IN EACH SYSTEM DIAGRAM.
2. P1-1, 2, 25, 26, 31, 35, 36, 39, 40, 44, 45, 46, P2-7, 8, 18, 21, 22, 25, 26, 49, 50
3. P1-1, 2, 25, 26, 45, 46, P2-7, 8, 25, 26, 49, 50
4. P1-1, 2, 20, 25, 26, 45, 46
5. P2-7, 8, 19, 20, 25, 26, 49, 50
6. P1-11, 12, 23, 24, 37, 38
7. SIGNAL LINES DOWC-L AND FIND-L ARE GROUNDED ON THE HP 7914 MOTHERBOARD PCA-A11.

Figure 4-14. Read/Write System Functional Block Diagram



7912-50

Figure 4-15. Servo PCA-A9 Layout



7912-27C

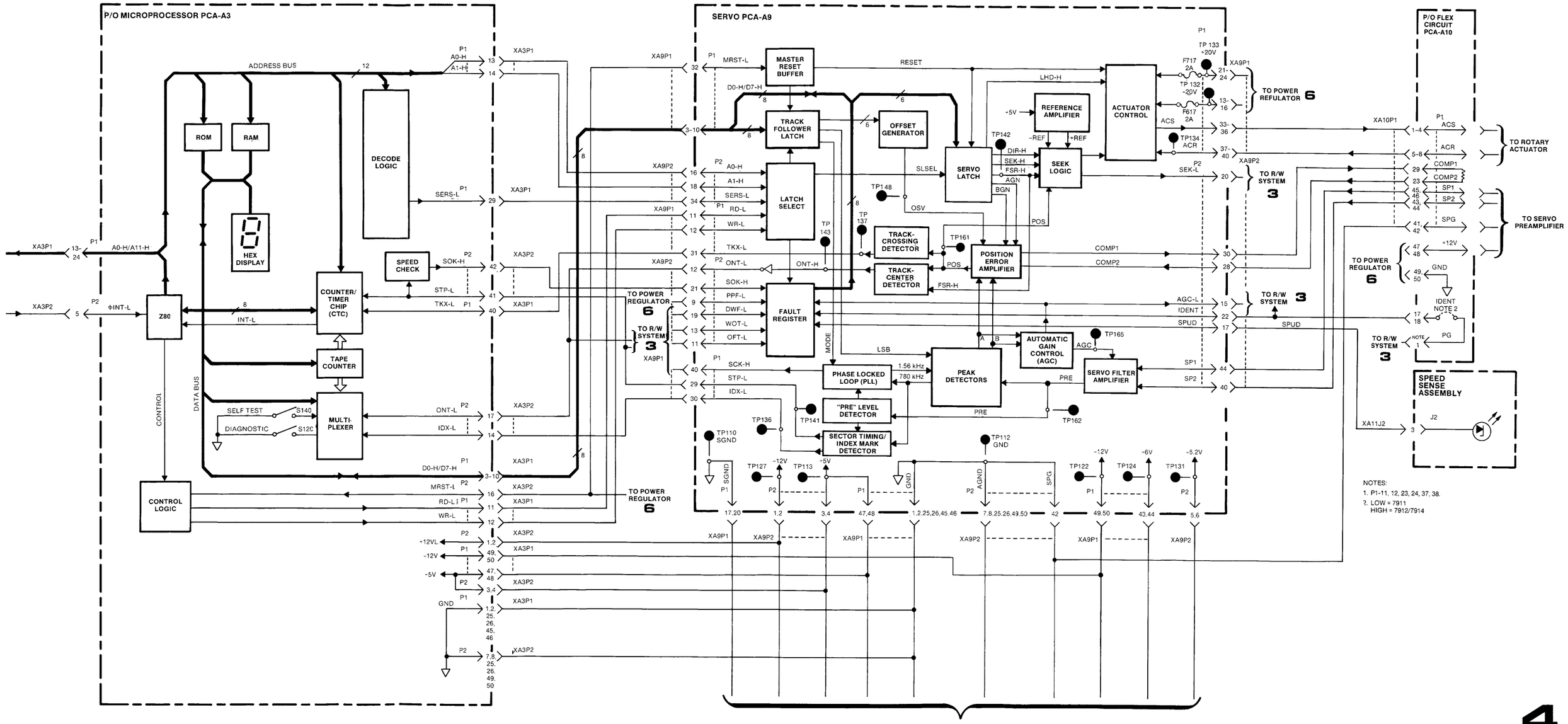
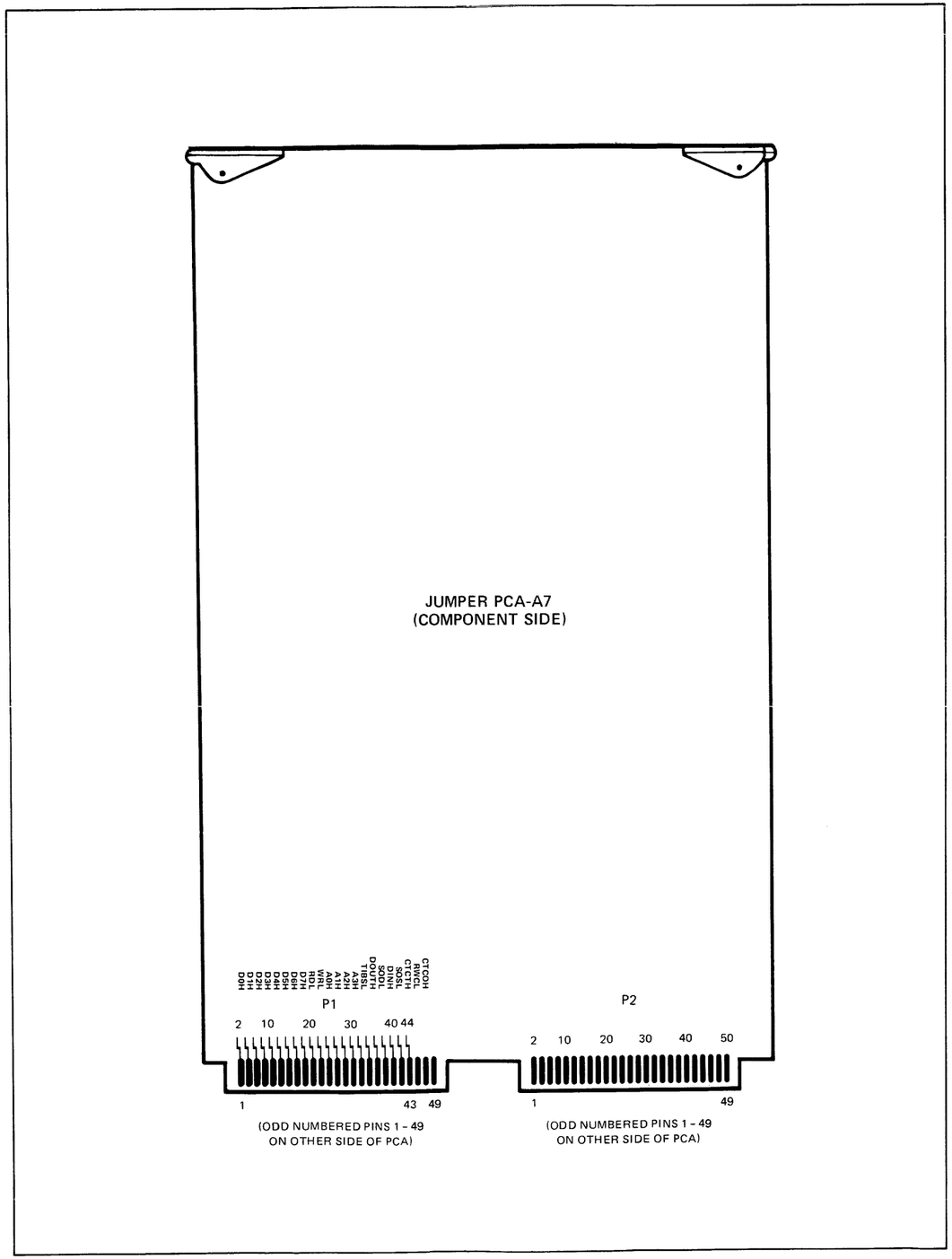
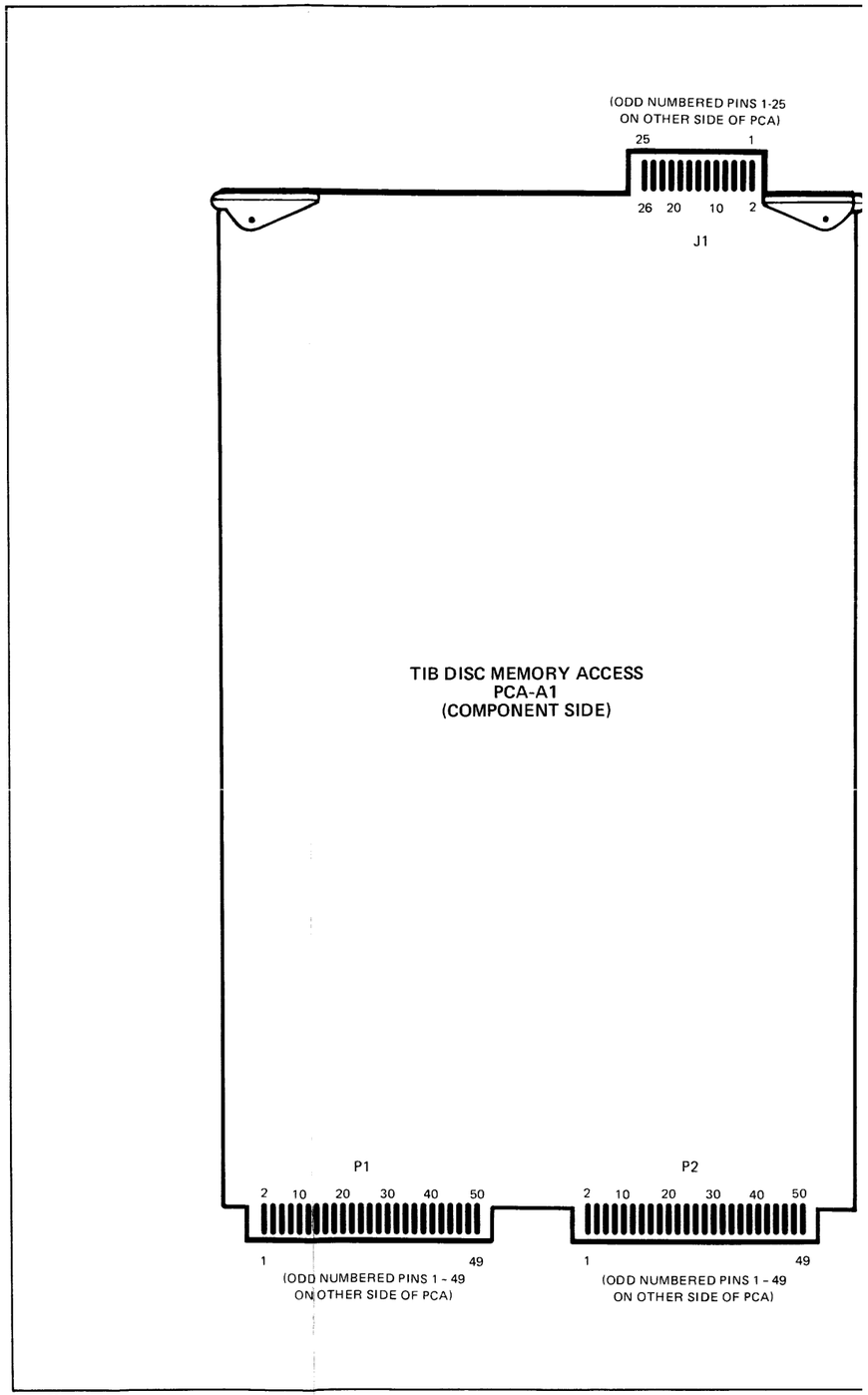


Figure 4-16. Servo System Functional Block Diagram



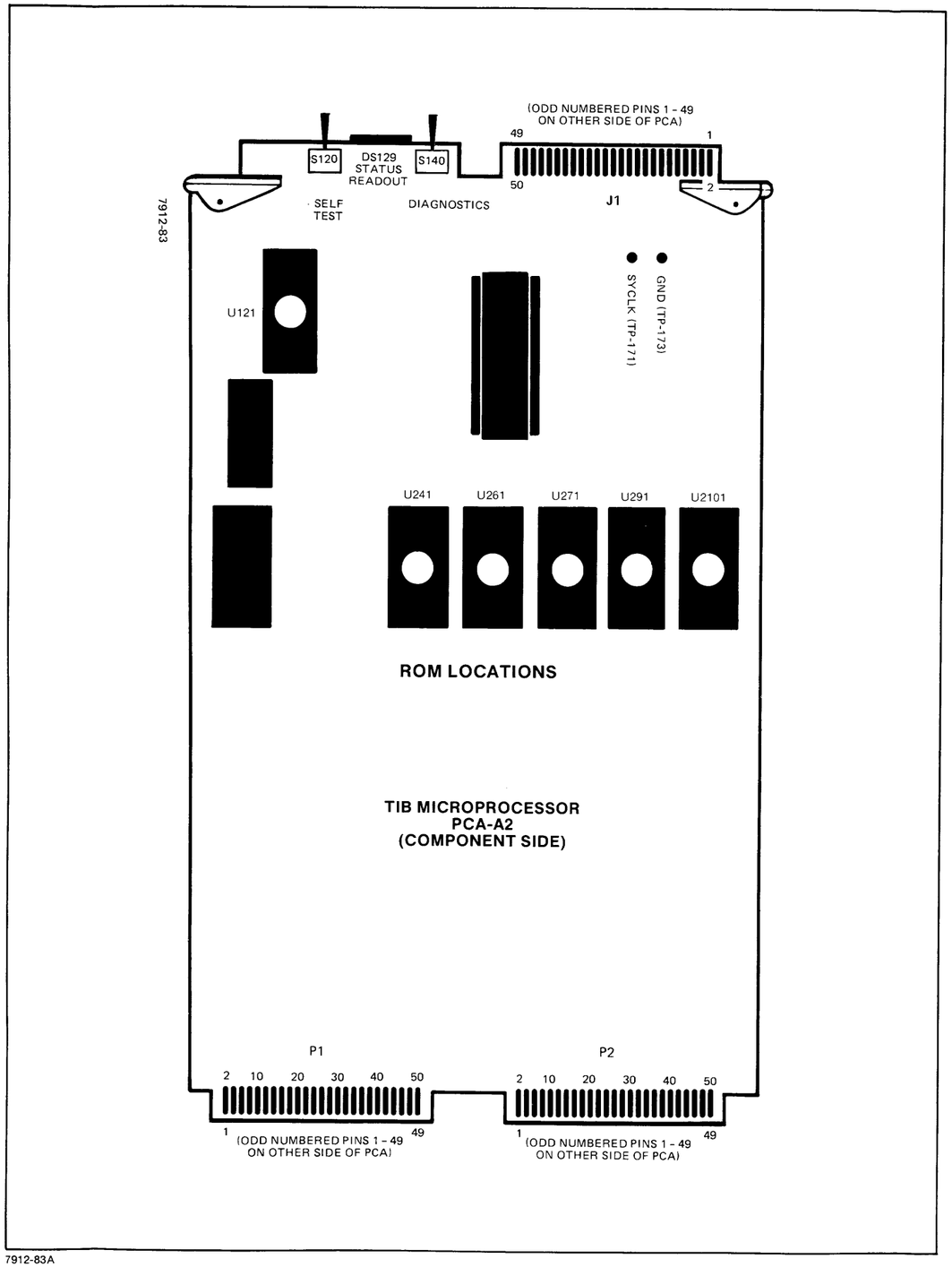
7912-52

Figure 4-17. Jumper PCA-A7 Layout



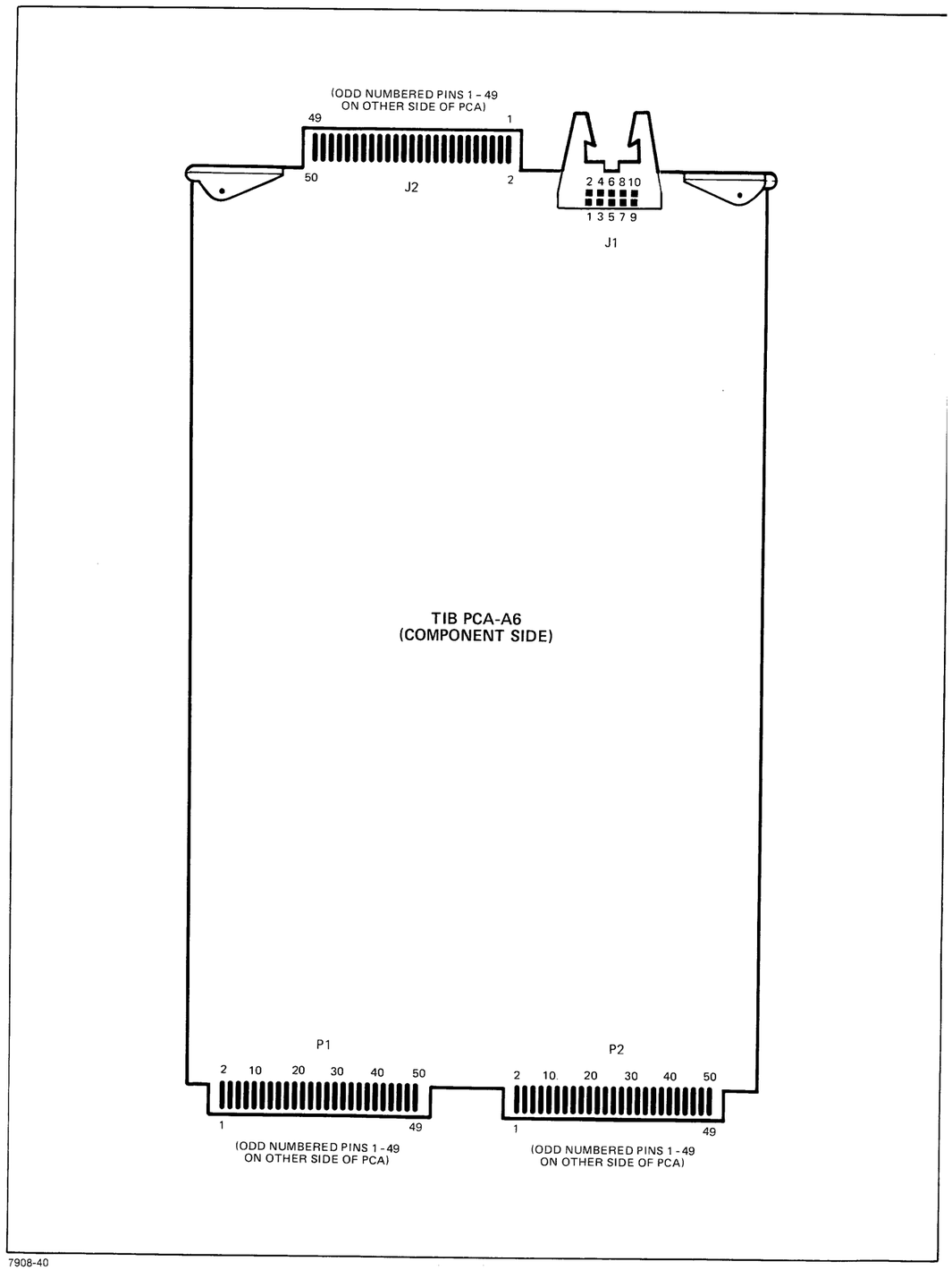
7912-56

Figure 4-18. TIB DMA PCA-A1 Layout



7912-83A

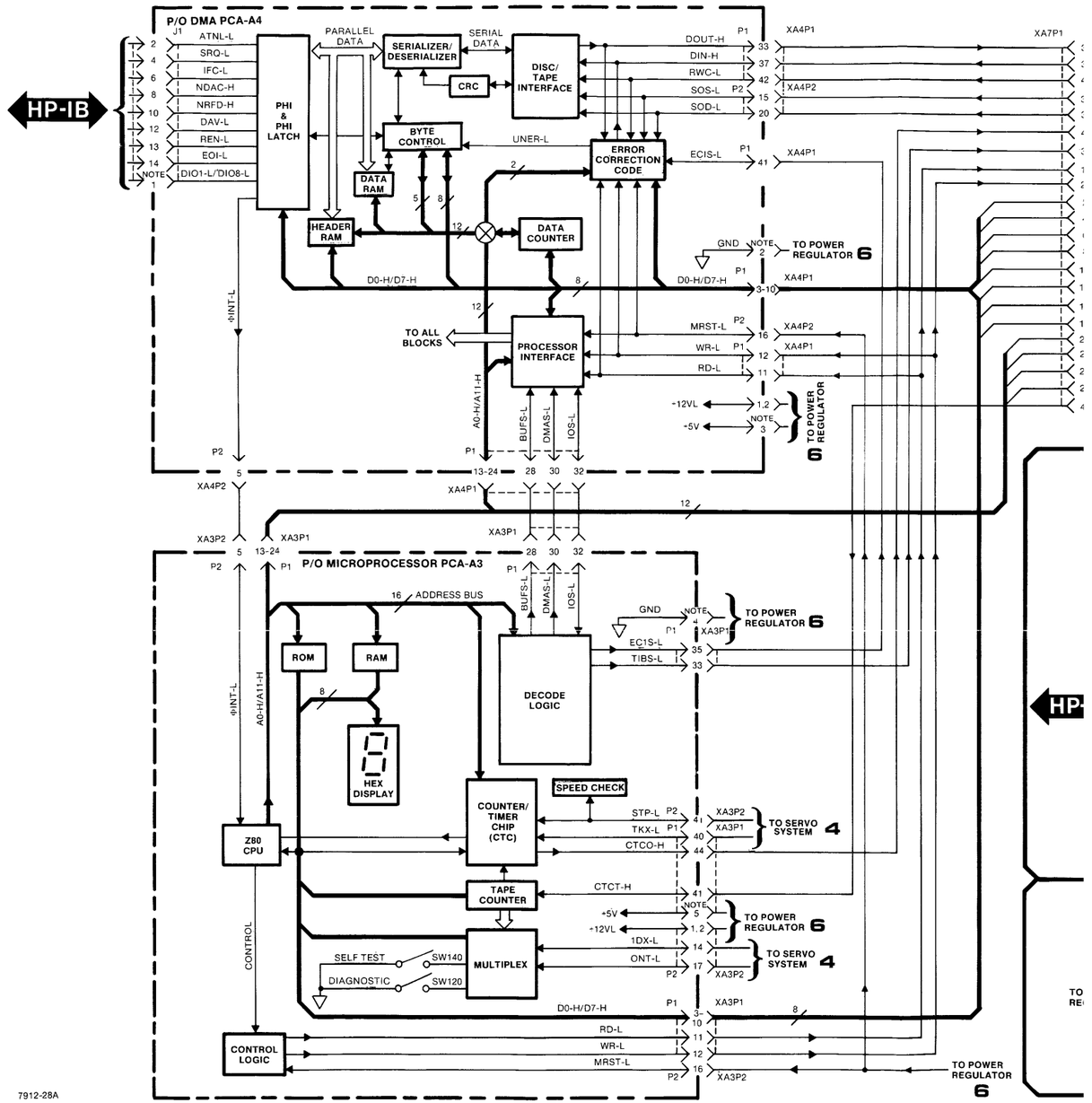
Figure 4-19. TIB UPROC PCA-A2 Layout

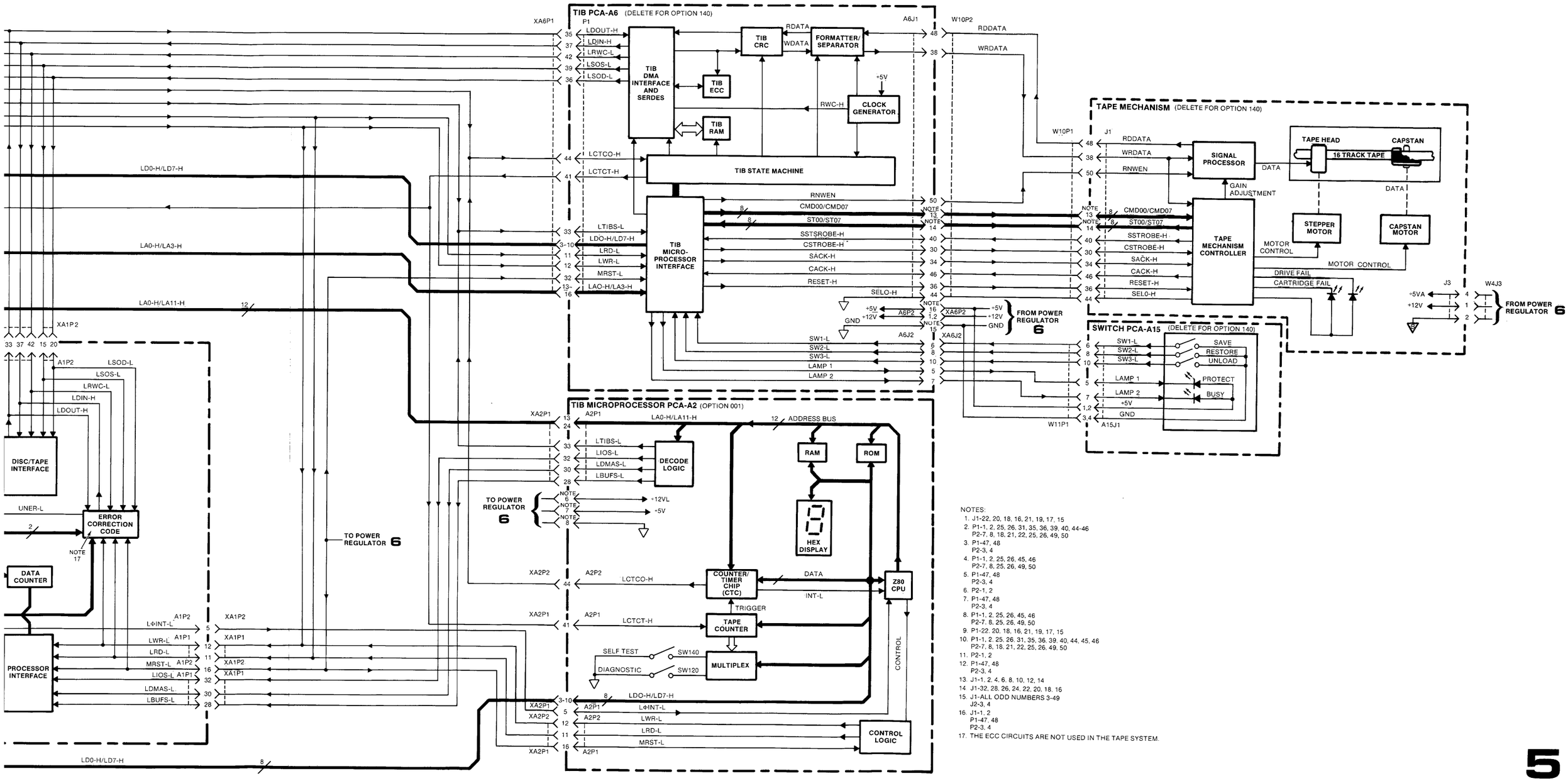


7908-40

Figure 4-20. Tape Interface Board PCA-A6 Layout

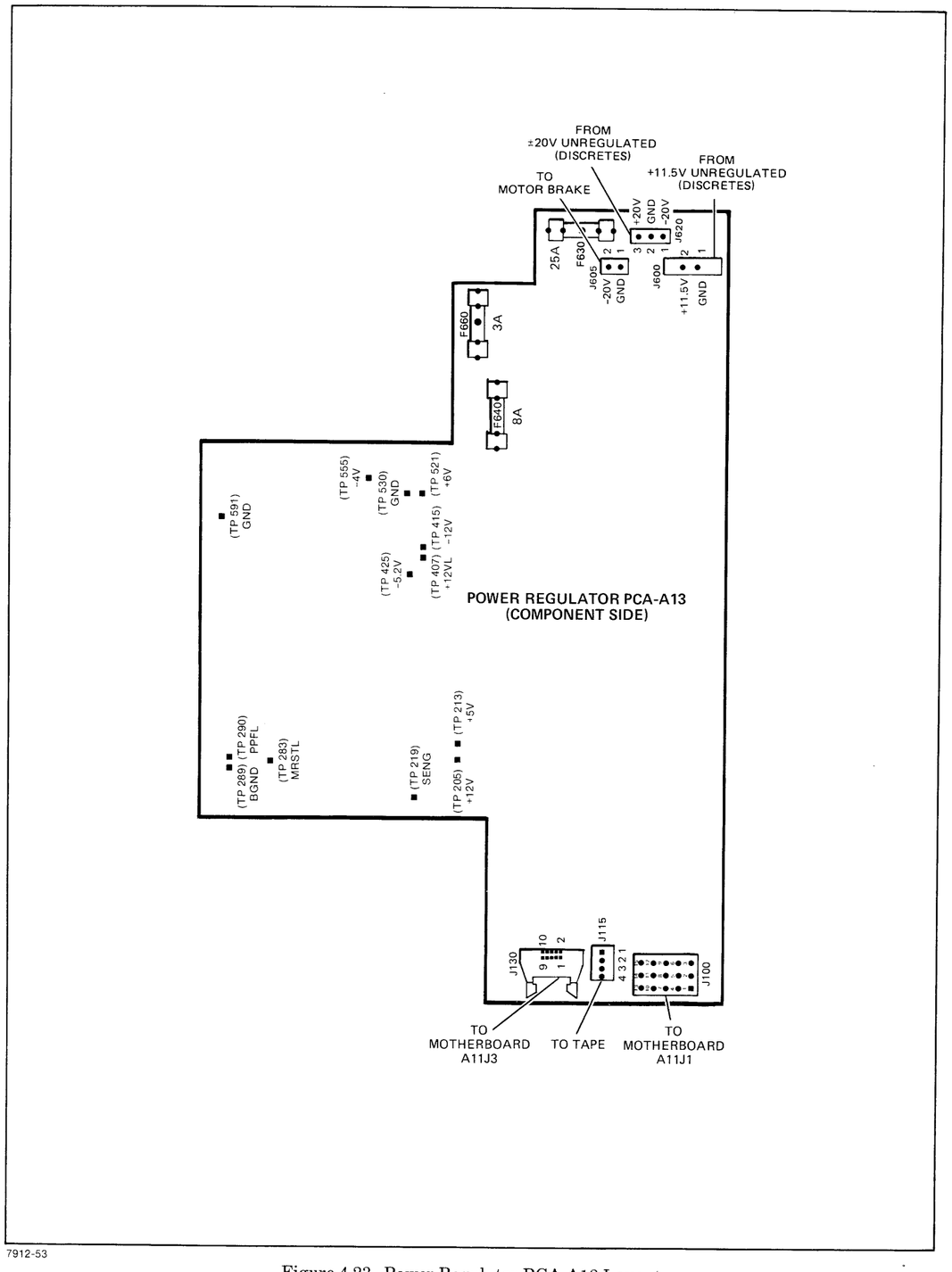
Figure 4-21. Switch PCA-A15 Layout





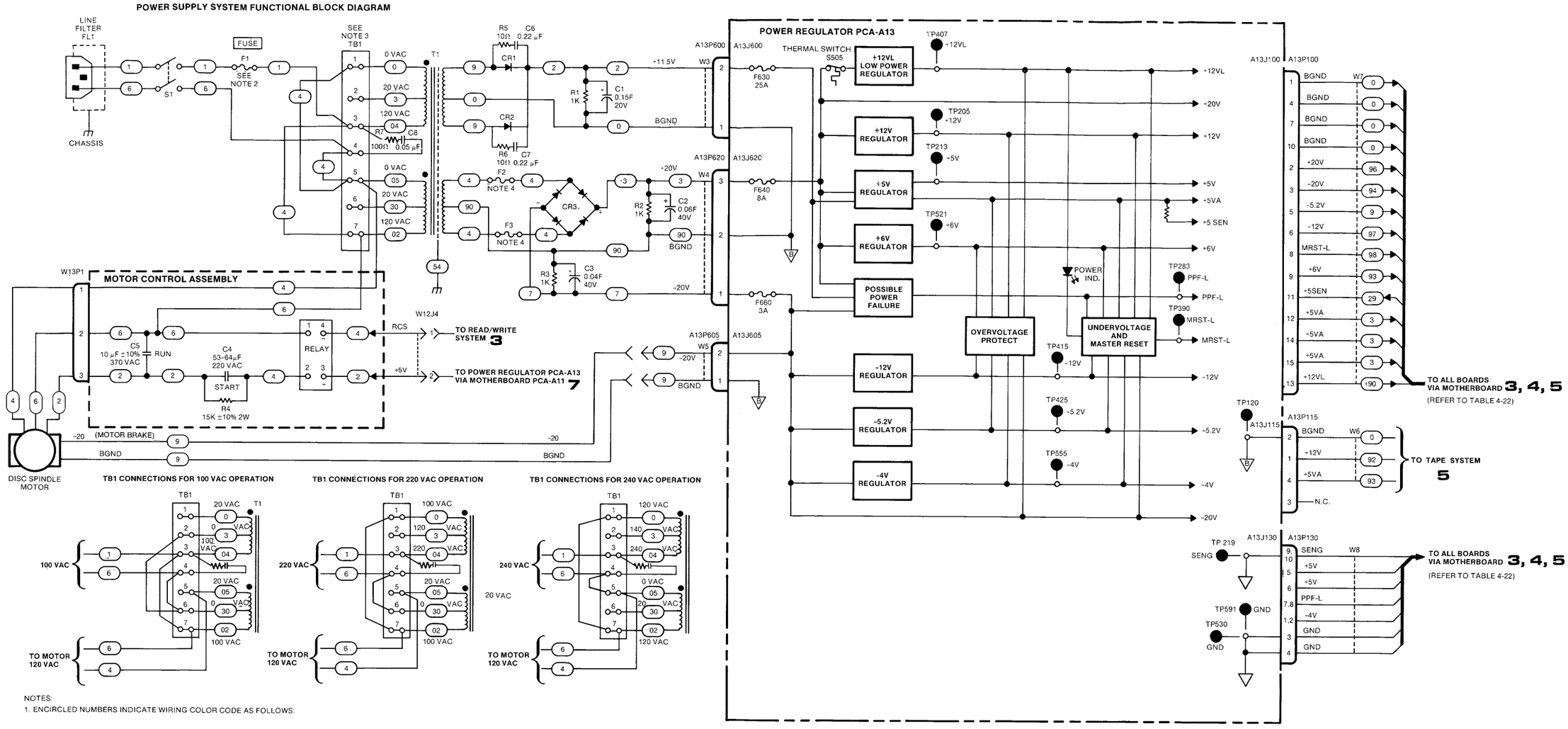
NOTES:
1. J1-22, 20, 18, 16, 21, 19, 17, 15
2. P1-1, 2, 25, 26, 31, 35, 36, 39, 40, 44-46
   P2-7, 8, 18, 21, 22, 25, 26, 49, 50
3. P1-47, 48
   P2-3, 4
4. P1-1, 2, 25, 26, 45, 46
   P2-7, 8, 25, 26, 49, 50
5. P1-47, 48
   P2-3, 4
6. P2-1, 2
7. P1-47, 48
   P2-3, 4
8. P1-1, 2, 25, 26, 45, 46
   P2-7, 8, 25, 26, 49, 50
9. P1-22, 20, 18, 16, 21, 19, 17, 15
10. P1-1, 2, 25, 26, 31, 35, 36, 39, 40, 44, 45, 46
    P2-7, 8, 18, 21, 22, 25, 26, 49, 50
11. P2-1, 2
12. P1-47, 48
    P2-3, 4
13. J1-1, 2, 4, 6, 8, 10, 12, 14
14. J1-32, 28, 26, 24, 22, 20, 18, 16
15. J1-ALL ODD NUMBERS 3-49
    J2-3, 4
16. J1-1, 2
    P1-47, 48
    P2-3, 4
17. THE ECC CIRCUITS ARE NOT USED IN THE TAPE SYSTEM.

Figure 4-22. Tape System Functional Block Diagram



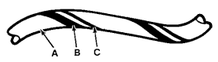
7912-53

Figure 4-23. Power Regulator PCA-A13 Layout



NOTES:

1. ENCIRCLED NUMBERS INDICATE WIRING COLOR CODE AS FOLLOWS:



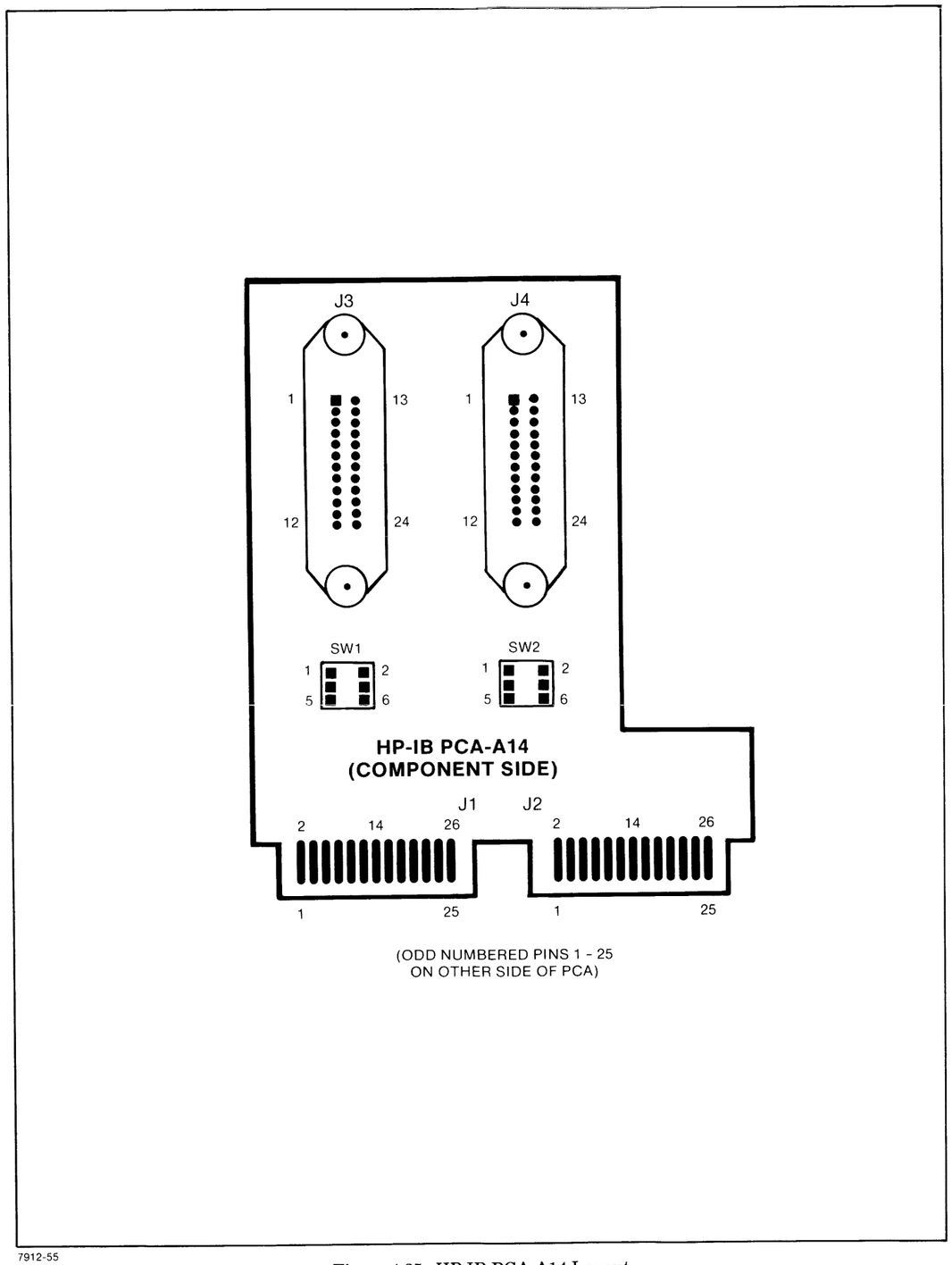
COLOI	1ST DIGIT A	2ND DIGIT B	3RD DIGIT C
BLACK	0	0	0
BROWN	1	1	1
RED	2	2	2
ORANG	3	3	3
YELLOV	4	4	4
GREEN	5	5	5
BLUE	6	6	6
VIOLET	7	7	7
GRAY	8	8	8
WHITE	9	9	9

7912-29C

2. FUSE F1 IS AS FOLLOWS:
   A. 100 VAC = 10A NB 250V 2110-0051
   B. 120 VAC = 10A NB 250V 2110-0051
   C. 220 VAC = 5A SB 250V 2110-0030
   D. 240 VAC = 5A SB 250V 2110-0030
3. TERMINAL BLOCK TB1 IS SHOWN CONFIGURED FOR 120 VAC OPERATION: TB1 CONNECTIONS FOR 100 VAC, 220 VAC, AND 240 VAC OPERATION ARE SHOWN ABOVE.
4. FUSES F2 AND F3 15A NB 250V 2110-0054.

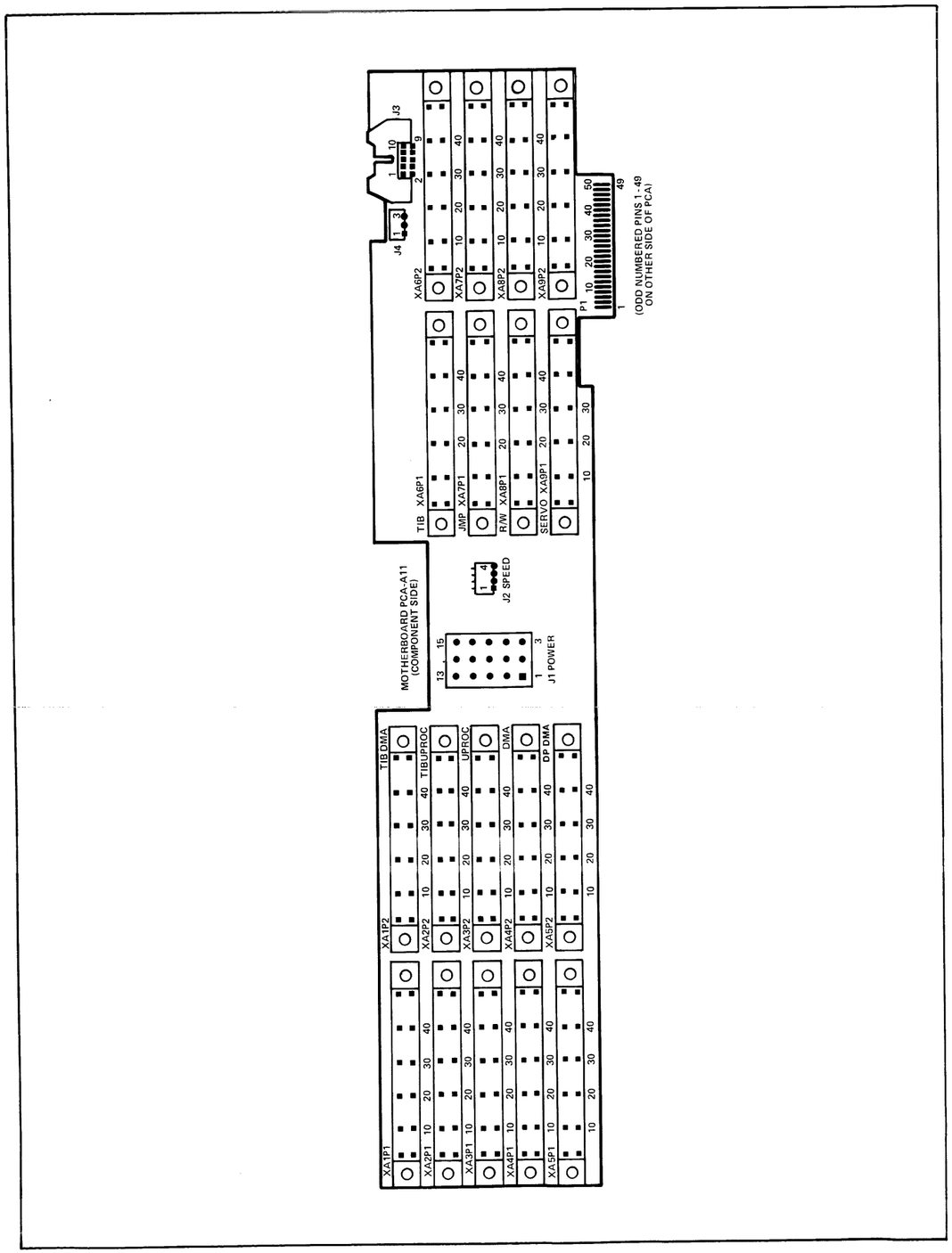
6

Figure 4-24. Power Supply System Functional Block Diagram



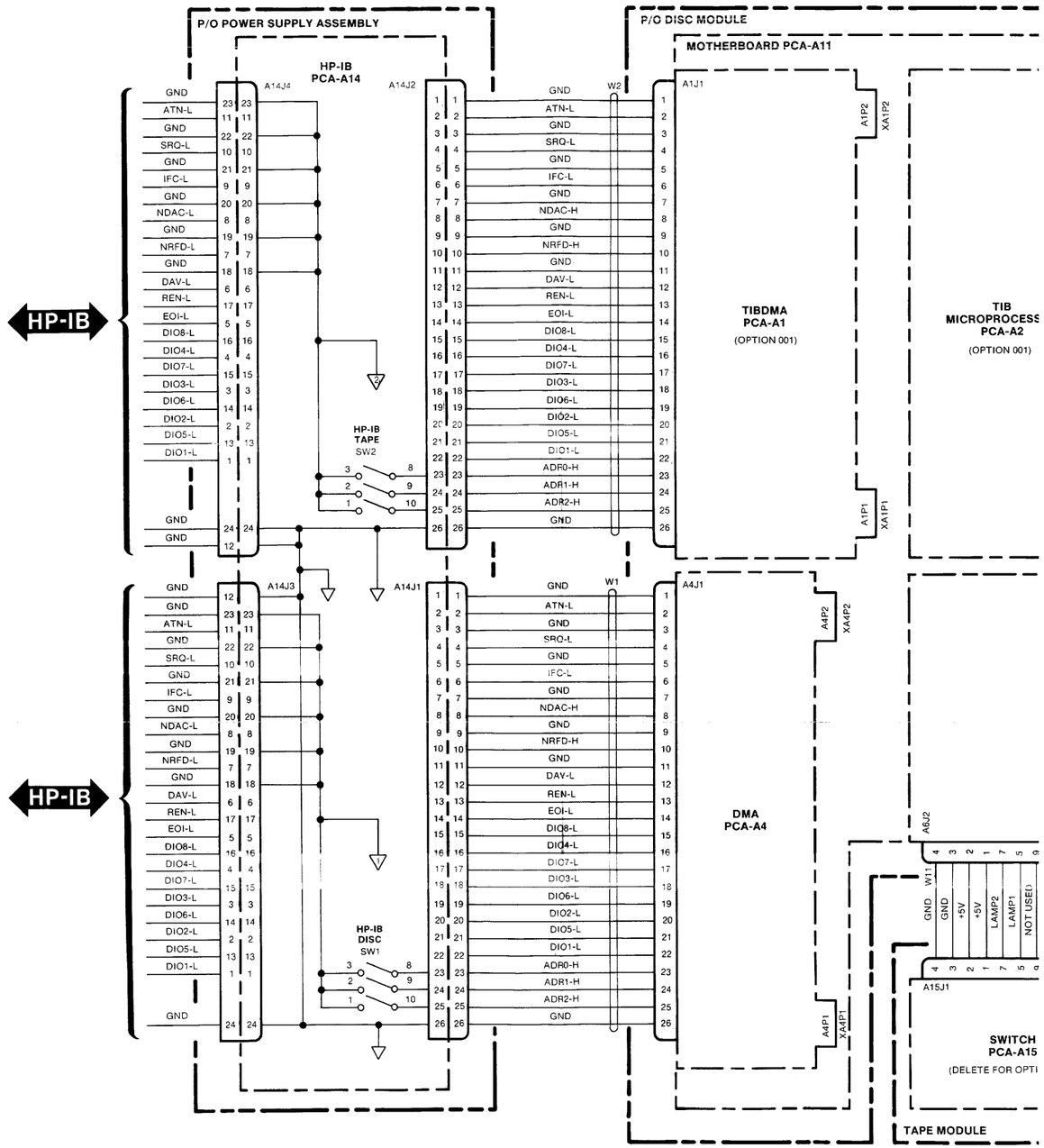
7912-55

Figure 4-25. HP-IB PCA-A14 Layout



7912-54A

Figure 4-26. Motherboard PCA-A11 Layout



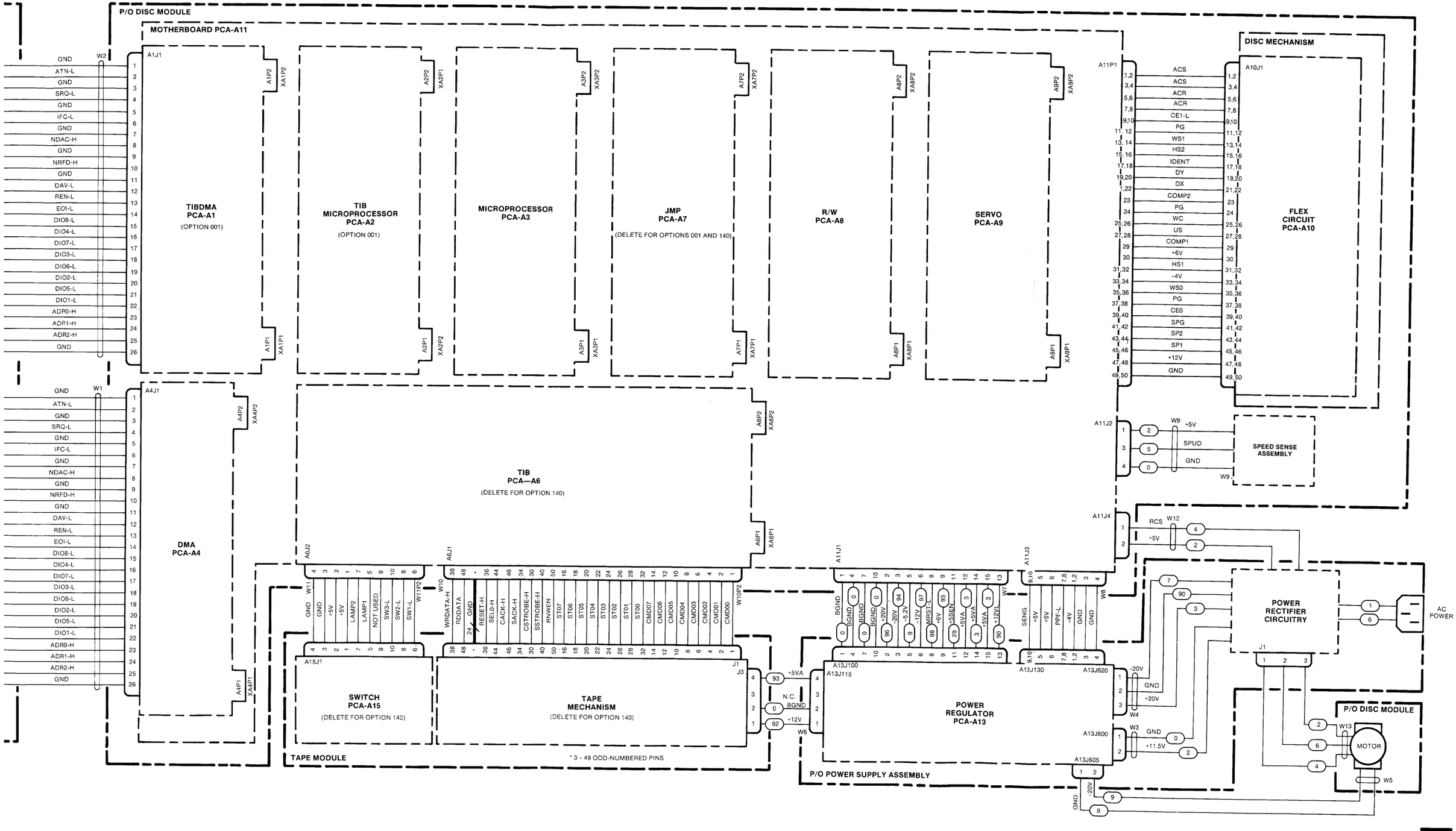


Figure 4-27. Wiring Interconnection Diagram

REMOVAL AND REPLACEMENT

SECTION V

5-1. INTRODUCTION

WARNING

The drives do not contain any operator-serviceable parts. To prevent electrical shock, refer all service activities to service-trained personnel.

This section contains detailed removal and replacement procedures for those drive assemblies and components which are field replaceable.

TORX® hardware is used in the assembly of the drive. This hardware requires the use of special drivers (refer to table 4-1). In this manual, any reference to this type of hardware will be accompanied by the appropriate driver size (e.g., T15).

5-2. PREPARATION PROCEDURES

WARNING

To avoid dangerous electrical shock, do not perform any removal/replacement operation until the ac main power is removed from the power supply which provides dc power for the drive.

All service procedures require the power cord to be disconnected. To remove the power cord, proceed as follows:

a. Set the POWER switch on the rear panel to the 0 (off) position.

b. Disconnect the ac power cord from the wall outlet and from the receptacle on the rear panel.

All service procedures require the HP-IB cable to be disconnected. The HP-IB cable is disconnected as follows:

CAUTION

Always ensure that power has been removed before disconnecting the HP-IB cable.

a. Remove the two thumb screws which hold the HP-IB connector in place.

b. Disconnect the HP-IB cable.

Note: To reconnect the HP-IB cable, first ensure that power is removed from the drive, then reverse the above procedure.

WARNING

Rackmount cabinets may be unstable when the drive is extended. Install anti-tip feet on the cabinet before extending the drive for service.

c. On rackmounted drives only, install the two anti-tip feet (provided in the service kit) onto the rack.

5-3. REMOVAL AND REPLACEMENT (STAND-ALONE DRIVE)

5-4. LOWER FRONT PANEL (1, figure 6-1)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel by pulling it forward from the top and disengaging the tabs at the bottom of the panel.

To replace, slide the bottom tabs into the mainframe and push the top into place.

5-5. UPPER FRONT PANEL (2, figure 6-1)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the upper front panel by pulling it forward. The upper front filler panel (3, Option 140) is removed by removing the one T15 mounting screw (4) located beneath the panel.

To replace, push the panel into place. Tighten the T15 filler panel screw (4, Option 140) to 10 inch-pounds.

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If either of the front panels does not fit properly in place, one or more stud retainers may need replacement. The defective stud retainer must be drilled out with a 0.125 inch bit (3.2 mm) from the front of the base assembly. The new stud retainer is held in place by two screws as shown in figure 6-1, detail C.

5-6. SWITCH PCA-A15 (9, figure 6-1)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the upper front panel (refer to paragraph 5-5).

d. Remove the two T15 screws (5) that attach the ESD shield (6) and the switch PCA-A15 (9) to the tape module (26).

e. Disconnect the switch cable (7) from the switch PCA-A15 (9).

To install, reverse the above procedure. Tighten the T15 screws removed in step d to 10 inch-pounds.

5-7. CARD CAGE ACCESS (figure 6-3)

Removal of the card cage shield provides access to a majority of the printed circuit assemblies (PCA's). To gain access, proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the lower front panel (refer to paragraph 5-4).

d. Loosen the two captive screws that hold the card cage shield assembly (1) to the card cage.

e. Remove the shield from the front of the card cage.

WARNING

The card cage shield assembly captive screws must be tightened to 15 inch-pounds to prevent operator access into the card cage.

To replace the card cage shield assembly, reverse the above procedure.

5-8. FLIP-TOP ASSEMBLY (12, figure 6-1)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)

d. Remove the four T15 screws (13) that hold the flip-top to the front of the cabinet base (51).

e. Rotate the flip-top upward from the front of the cabinet to the rear and rest the flip-top on the rear panel.

f. Remove the two screws (15) which secure the ground straps to the flip-top assembly.

g. Disengage the flip-top assembly from the cabinet base.

To install the flip-top, proceed as follows:

a. Engage the bottom rear tabs of the flip-top with the bottom rear portion of the cabinet base and rest the flip-top on the rear panel.

b. Install the two ground strap screws (15).

c. Rotate the flip-top until it is resting on and aligned with the cabinet front frame.

d. Install the four T15 screws (13) and tighten to 25 inch-pounds.

5-9. STORAGE BOX (17, figure 6-1)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the upper front panel (refer to paragraph 5-5).

d. Remove the three T15 screws (18) that hold the storage box (17) to both the front of the cabinet base (51) and the right side tape module bracket (24).

e. Remove the storage box.

To install, reverse the above procedure. Tighten the T15 screws removed in step d to 10 inch-pounds.

5-10. TAPE MODULE (26, figure 6-1)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Switch PCA-A15 (refer to paragraph 5-6)
- Flip-top assembly (refer to paragraph 5-8)
- Storage box (refer to paragraph 5-9)

d. Remove the tape power cable (20) and tape data cable (19) from the rear of the tape module.

e. Remove the four T15 screws (21) that hold the tape module brackets (22, 24) to the cabinet base (51).

f. Remove the tape module.

Note: If a new tape module is to be installed, the brackets (22, 24) on the front of the defective tape module must be removed and installed on the new tape module.

To install the tape module, proceed as follows:

a. Install the left tape module bracket (22) on the new tape module using the two T15 screws (23). Tighten these screws to 10 inch-pounds.

b. Install, but do not tighten, the right tape module bracket (24) on the new tape module using the two T15 screws (25).

c. Install the tape module in the cabinet base (51) using the four T15 screws (21). Tighten these screws to 10 inch-pounds.

d. Tighten the two T15 screws (25) in the right tape module bracket to 10 inch-pounds.

e. Reverse steps a through d of the removal procedure.

5-11. POWER SUPPLY ASSEMBLY (see figure 6-4)

To remove, repair, or replace the power supply, proceed as follows:

Note: If it is necessary to only gain access to the interior of the power supply, skip steps f through j.

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Flip-top assembly (refer to paragraph 5-8)

d. Remove the two T15 screws that hold the power supply door in place (see figure 5-1).

e. Disconnect the cable(s) from the HP-IB PCA-A14 and swing the hinged door open.

f. Open the two cable clips (19, figure 6-4) and pull the two-wire brake cable free.

g. Disconnect all cables connected to the power supply assembly from external assemblies.

Note: During assembly, when the cables are connected to the power regulator PCA-A13, the ribbon cable should be routed beneath the other two cables to prevent pinching the cable in the power supply door.

h. Remove the T30 screw (28, figure 6-1) that attaches the ground strap (27) to the power supply chassis.

i. Remove the four T25 screws (41) that hold the power supply to the cabinet base (51).

Note: During reassembly, ensure that all ground straps are properly installed.

j. Lift the power supply out of the frame.

To reassemble, reverse the above procedure. Tighten the screws removed in steps d, h, and i as follows:

Step	Screw	Torque Setting (inch-pounds)
d	T15	25
h	T30 (28)	60
i	T25 (41)	40

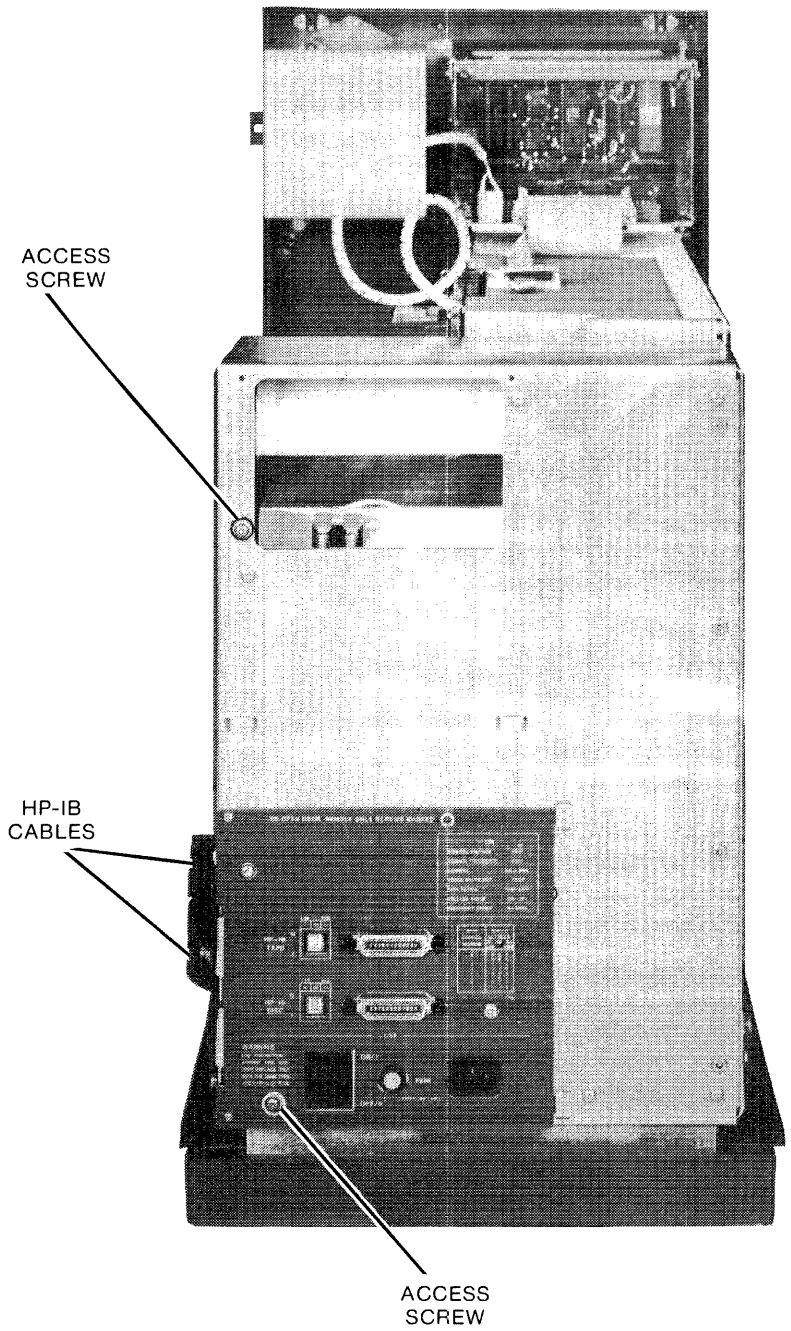


Figure 5-1. Stand-Alone Drive Power Supply Access Screws

5-12. SHIPPING LOCKS (see figure 5-2)

The drives are shipped with the disc spindle and actuator locked to prevent damage to the disc mechanism. Before operating the drive, the shipping locks must be set to the OPERATE position. To unlock the spindle and actuator, proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Flip-top assembly (refer to paragraph 5-8)

d. Loosen the T15 screw which holds the spindle lock in place.

e. Using a flat blade screwdriver, pry the spindle lock to the OPERATE position. Tighten the T15 screw to 20 inch-pounds.

f. Turn the actuator lock to the OPERATE position.

To reassemble, install the items removed in step c.

To lock the disc mechanism, perform the above procedure but move the locks to the SHIP position.

Note: When locking the spindle, ensure that the spindle lock is wedged tightly under the spindle pulley.

5-13. DISC MODULE (48, figure 6-1)

WARNING

The disc module weighs 34 kg (75 lbs). It requires two people to lift it.

CAUTION

Bumping or dropping the disc module can cause damage to the heads and/or media. This damage can occur even with the shipping locks engaged. To avoid damage, use great care when handling the disc module.

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Card cage shield and all PCA's (refer to paragraph 5-7)
- Flip-top assembly (refer to paragraph 5-8)
- Storage box (refer to paragraph 5-9)
- Tape module (refer to paragraph 5-10)
- Power supply (refer to paragraph 5-11)

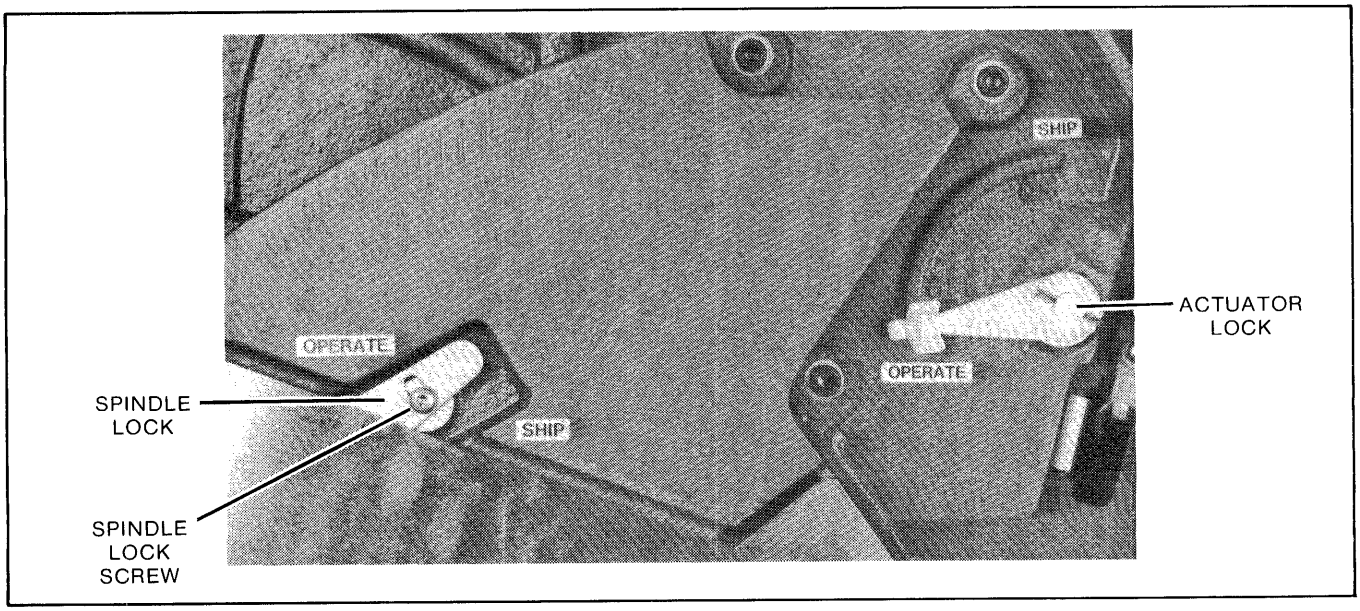


Figure 5-2. Shipping Locks

d. Remove the two 1/2-inch nuts (46) from the front shock mounts.

e. Remove the two 1/2-inch nuts (46) from the base shock mounts.

f. Set the two shipping locks to the SHIP position (refer to paragraph 5-12).

g. Disconnect all cables connected to the disc module.

h. Remove the two T30 screws (28, 31) that attach the ground straps (27, 30) to the disc module.

i. Using two people, lift the disc module from the cabinet base.

j. Remove the two T30 screws (50) that hold the mounting bracket (49) on the bottom, rear of the disc module.

k. Install the mounting bracket on the new disc module and tighten the T30 screws (50) to 80 inch-pounds.

l. Unscrew the two shock mounts (47) from the disc module and install them on the new disc module. The shock mounts are installed finger tight.

m. Remove the following cables and install them on the new disc module:

- Tape power cable (20)
- Tape TIB cable (19)
- Switch PCA-A15 cable (7)
- HP-IB cable(s) (35, 36)

n. Using two people, place the new disc module back into the cabinet base.

o. Install all four 1/2-inch nuts (46) and tighten to 60 inch-pounds.

p. Attach the two ground straps (27, 30) to the disc module using the two T30 mounting screws (28, 31). Tighten these screws to 60 inch-pounds.

q. Connect all cables to the disc module.

r. Set the two shipping locks to the OPERATE position (refer to paragraph 5-12).

s. Replace the following items:

- Power supply (refer to paragraph 5-11)
- Tape module (refer to paragraph 5-10)
- Storage box (refer to paragraph 5-9)
- Flip-top assembly (refer to paragraph 5-8)
- All PCA's and card cage shield (refer to paragraph 5-7)
- Upper front panel (refer to paragraph 5-5)
- Lower front panel (refer to paragraph 5-4)

5-14. SHOCK MOUNTS (47, figure 6-1)

To replace the shock mounts, proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Flip-top assembly (refer to paragraph 5-8)
- Storage box (refer to paragraph 5-9)
- Tape module (refer to paragraph 5-10)
- Power supply (refer to paragraph 5-11)
- Disc module (refer to paragraph 5-13)

d. Turn the two shock mounts (47) on the cabinet base (51) counterclockwise until they can be removed from the cabinet base.

Note: The shock mounts are installed finger tight.

e. Install two new shock mounts into the cabinet base.

f. Turn the two shock mounts (47) on the disc module counterclockwise until they can be removed from the frame.

g. Install two new shock mounts into the disc module. The shock mounts are installed finger tight.

To reassemble, install the items removed in step c.

5-15. DISC MECHANISM COVER (14, figure 6-3)

The disc mechanism cover must be removed to remove or repair the following items:

- Speed sensor
- Motor
- Motherboard PCA

To remove the disc mechanism cover proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Flip-top assembly (refer to paragraph 5-8)

d. Remove the nine T20 screws (15) that hold the cover on the disc mechanism.

Note: To simplify removal, avoid catching the cover on the edge of the disc mechanism directly under the tape module.

e. Pull the cover away from the disc mechanism.

To install, reverse the above procedure. Tighten the T20 screws (15) removed in step d to 15 inch-pounds.

5-16. MOTHERBOARD PCA-A11 (26, figure 6-3)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Card cage shield and all PCA's (refer to paragraph 5-7)
- Flip-top assembly (refer to paragraph 5-8)
- Disc mechanism cover (refer to paragraph 5-15)

d. Disconnect all the cables from the motherboard PCA-A11 (26).

e. Remove the two T20 screws (17, 21) that attach the mounting brackets (16, 20) to the disc mechanism and remove the small bracket (20).

f. Remove the motherboard PCA-A11 (26).

Note: The motherboard PCA-A11 fits tightly in the slots. Hold the board at the center, or pull equally at the top and bottom, to prevent the board from jamming in the slots.

g. Remove the screw (19) that attaches the large bracket (16) to the motherboard.

h. Remove the large bracket.

CAUTION

When installing the motherboard PCA-A11, ensure that the two lockwashers (17A and 18) are reinstalled when mounting the large bracket to the mechanism. Failure to reinstall both washers could result in grounding problems.

Installation of the motherboard PCA-A11 is the reverse of this procedure. Tighten the T20 screws (17, 21) removed in step e to 20 inch-pounds.

5-17. DRIVE BELT COVER (31, figure 6-3)

Removal of the drive belt cover provides access to the following items:

- Drive belt
- Pulleys
- Spring tensioning system
- Motor
- Spindle pulley lock
- Speed sensor

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power.

c. Remove the following items:

- Lower front panel (refer to paragraph 5-4)
- Upper front panel (refer to paragraph 5-5)
- Flip-top assembly (refer to paragraph 5-8)

d. Remove the four T15 screws (32) that mount the drive belt cover to the disc mechanism.

To replace the drive belt cover, proceed as follows:

CAUTION

Ensure that the grounding strip on the drive belt cover is rotated so the hole in the strip is aligned with the nearest hole in the drive belt cover. Failure to do this may damage the grounding strip and cause loss of data.

a. Place the cover on the disc mechanism and install a T15 screw (32) in the hole aligned with the grounding strip. Tighten this screw finger tight.

b. Install the other three T15 screws (32) and tighten all four screws to 20 inch-pounds.

5-18. BLOWER WHEEL (30, figure 6-3)

The blower wheel on the motor can be replaced without removing the motor. To remove the blower wheel proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Remove the following items:

- Power supply (refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives)
- Disc mechanism cover (refer to paragraph 5-15 for stand-alone drives; refer to paragraph 5-47 for rackmount drives)

d. Remove the three T7 screws (28) which secure the blower wheel cover (27).

e. Using a 1/8 inch allen driver, loosen the allen setscrew that attaches the blower wheel to the motor shaft. The setscrew is located inside the blower wheel on the hub.

f. Place the new blower wheel on the motor shaft and tighten the setscrew to 75 inch-pounds.

To reassemble, install the items removed in steps d and c. Tighten the T7 screws (28) removed in step d to 5 inch-pounds.

5-19. MOTOR BRAKE (51, figure 6-3)

The motor brake is mounted on the motor (45) directly behind the blower wheel (30). The brake can be replaced without removing the motor.

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Remove the following items:

- Power supply (refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives)
- Disc mechanism cover (refer to paragraph 5-15 for stand-alone drives; refer to paragraph 5-47 for rackmount drives)
- Blower wheel (refer to paragraph 5-18)

d. Feed the brake cable through the disc mechanism (see figure 5-3).

e. Remove the T25 screw (52) which secures the cable clamp (55) to the motor (45).

Note: During installation, the cable clamp must be mounted with the screw located at the top of the motor (next to the power cable).

f. Remove the remaining three T25 screws (52) that mount the brake to the motor.

g. Slide the brake off the motor shaft.

CAUTION

During motor brake installation, remove all slack in the brake cable where it routes through the disc mechanism. Damage to the cable may result if the cable touches the blower wheel.

To install, reverse the above procedure. Tighten the T25 screws removed in step f to 70 inch-pounds, and the T25 screw removed in step e to 35 inch-pounds.

5-20. SPEED SENSOR ASSEMBLY (56, figure 6-3)

a. Perform preparation procedures (refer to paragraph 5-2).

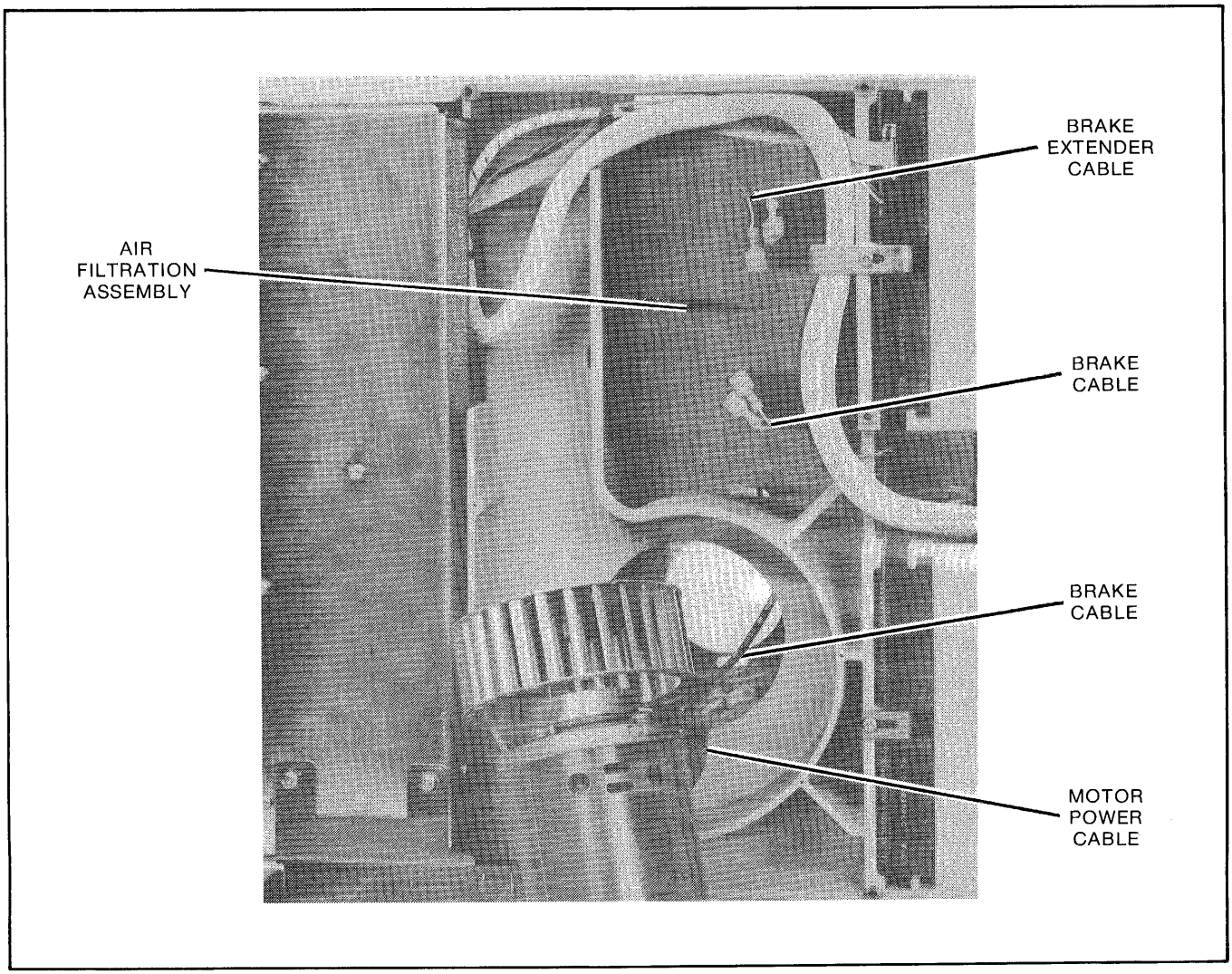


Figure 5-3. Disc Drive Motor Power and Brake Cable Routing

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Remove the following items:

- Disc mechanism cover (refer to paragraph 5-15 for stand-alone drives; refer to paragraph 5-47 for rackmount drives)
- Drive belt cover (refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives)

d. Disconnect the speed sensor cable from the motherboard PCA-A11 (26).

e. Remove the two T15 screws (57) that attach the speed sensor assembly to the disc mechanism (11).

f. Pull the speed sensor cable through the disc mechanism.

To replace the speed sensor assembly, proceed as follows:

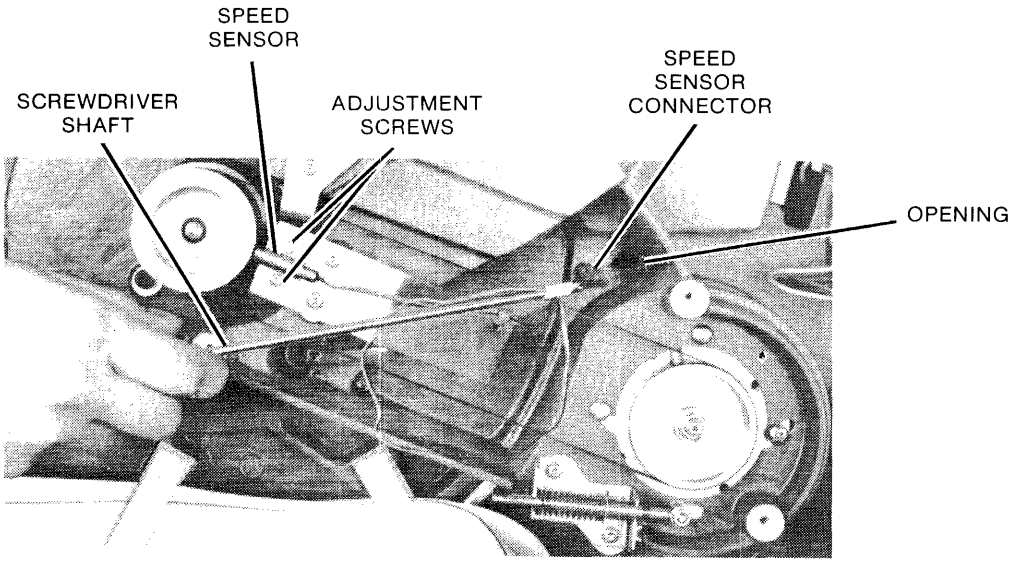
a. Install the speed sensor assembly on the disc mechanism using the two T15 mounting screws (57). Tighten these screws to 20 inch-pounds.

b. Tape the cable connector to a long screwdriver or a stiff wire (see figure 5-4A).

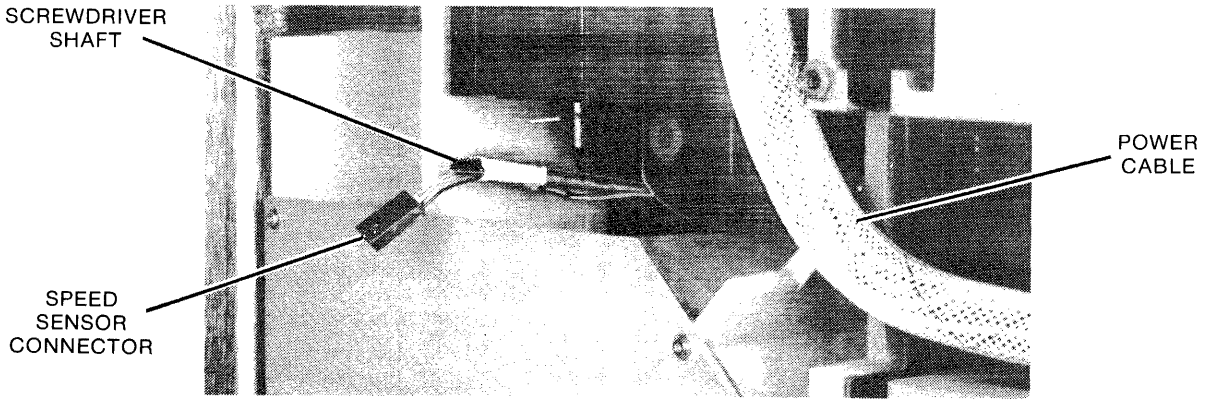
CAUTION

When feeding the speed sensor cable through the disc mechanism, ensure that the cable is routed behind the drive belt and not over the top of it.

c. Feed the screwdriver (or wire) through the opening in the disc mechanism (see figure 5-4B).



A



B

Figure 5-4. Speed Sensor Assembly Replacement

d. Untape the connector and carefully pull the cable through the disc mechanism. Route the cable beneath the power cable.

e. Connect the speed sensor cable to the motherboard PCA-A11 (26, figure 6-3).

f. Loosen the two T10 adjustment screws (see figure 5-4A) which mount the speed sensor transducer to the speed sensor assembly.

g. Using a gauge, adjust the speed sensor transducer to provide a 1 mm (0.04 in.) gap between the transducer and the spindle pulley.

h. Tighten the two T10 screws loosened in step f to 5 inch-pounds.

i. Install the following items:

- Disc mechanism cover (refer to paragraph 5-15 for stand-alone drives; refer to paragraph 5-47 for rackmount drives)
- Drive belt cover (refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives)

5-21. DRIVE BELT (36, figure 6-3)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Remove the drive belt cover. (Refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives.)

d. Remove the spindle shipping lock (33) by removing the two T15 screws (34) that mount the lock to the disc mechanism.

e. Loosen 3/4 turn the T25 motor mounting screw (46) directly opposite the tension stud spacer (50).

f. Loosen 2 turns the other two T25 motor mounting screws (46).

g. Loosen the 8 mm nut (48) on the tension stud.

h. Using the motor pulley (43), move the motor toward the spindle and, while holding the motor in this position, tighten the 8 mm nut (48) on the tension stud.

i. Remove the drive belt (36).

j. Place the new belt around the spindle pulley and around the motor pulley, ensuring that the side of the belt with the part number stamped on it is to the outside.

k. Loosen the 8 mm nut (48) on the tension stud.

CAUTION

Do not turn the spindle in a clockwise direction.

l. Manually rotate the motor pulley counterclockwise until the drive belt is centered on the motor pulley. Also ensure that the full width of the drive belt lies on the spindle pulley.

m. Using the tension stud, push the motor (45) toward the rear of the drive and then release. This removes any friction in the motor mounting and allows the spring tension assembly to establish the proper drive belt tension.

n. Tighten the 8 mm nut (48) on the tension stud securely.

o. Starting with the screw opposite the tension stud, tighten the three motor mounting screws (46) to 50 inch-pounds.

p. Install the spindle shipping lock (33) using the two T15 lock mounting screws (34). Tighten the screws to 20 inch-pounds while holding the lock toward the OPERATE position.

q. Install the drive belt cover. (Refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-48 for rackmount drives.)

5-22. SPRING TENSION ASSEMBLY (37, figure 6-3)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Remove the following items:

- Drive belt cover (refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives)
- Drive belt (refer to paragraph 5-21)

d. Remove the two T15 screws (38) that hold the spring tension assembly (37) in place.

To replace spring tension assembly, proceed as follows:

a. Loosen the 8 mm nut (48) on the tension stud.

b. Using the tension stud, push the motor (45) toward the rear of the drive (away from the spindle pulley).

c. Position the spring tension assembly so the holes are aligned with the disc mechanism and the long end of the spring tension arm is aligned with the tension stud.

d. Install the two T15 screws (38) that hold the spring tension assembly in position and tighten to 20 inch-pounds

e. Using the motor pulley (43), move the motor fully toward the spindle and, while holding the motor in this position, tighten the 8 mm nut (48) on the tension stud.

f. Install the drive belt and adjust the belt tension as outlined in paragraph 5-21.

g. Install the drive belt cover. (Refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-48 for rackmount drives.)

5-23. MOTOR (45, figure 6-3)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

WARNING

Do not attempt to change the motor without first removing the spring tension assembly.

c. Remove the following items:

- Disc mechanism cover (refer to paragraph 5-15 for stand-alone drives; refer to paragraph 5-47 for rackmount drives)
- Drive belt cover (refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives)
- Drive belt (refer to paragraph 5-21)
- Spring tension assembly (refer to paragraph 5-22)

d. Remove the three T7 screws (28) which secure the blower wheel cover (27).

e. Disconnect the brake cable (W5) at the two connectors above the air filtration assembly (see figure 5-3).

f. Remove the two T15 screws (39, 41, figure 6-3) that attach the motor ground wire and the motor power cable clamp to the disc mechanism. Do not drop the lock washer (40) located beneath the ground wire.

g. Unplug the motor cable W13 from connector J1 located on the power supply chassis.

h. Holding the blower wheel (30), remove the 8 mm nut (48) and spacer (50), then remove the three T25 screws (46) from the motor (45).

i. Gently ease the motor through the disc mechanism, being careful to guide the cable assemblies through the disc mechanism (11).

j. Using a 1/8 inch allen wrench, loosen the setscrew that holds the blower wheel (30) on the motor shaft.

k. Slide the blower wheel off the motor shaft and install it on the new motor shaft. Tighten the setscrew to 75 inch-pounds.

l. Using a 3/4 inch open end wrench to hold the pulley (43), remove the 1/2 inch nut (42) on the motor shaft and slide the pulley off the motor shaft, being careful not to lose the woodruff key (44).

CAUTION

Do not wrap or wind cables around the motor shaft. Ensure that all slack in the cables is removed after the motor is installed to prevent damage to the cables.

m. Feed the power and brake cables through the disc mechanism (see figure 5-3).

n. Connect the brake cable to the extender cable.

o. Align the motor so the tension stud can feed through the slotted hole in the disc mechanism.

p. While removing slack on the motor power cable and brake cable, carefully push the motor into the disc mechanism until the tension stud feeds through the slotted hole.

Note: It may take several tries to feed the motor assembly and cables through properly.

q. Rotate the motor until the mounting hole opposite the tension stud is aligned and install a T25 motor mounting screw (46, figure 6-3). Tighten the screw, then loosen it one-half turn.

r. Install the other two T25 motor mounting screws (46) until tight, then loosen one full turn.

s. Slide the spacer (50) over the tension stud and install the 8 mm nut (48). Tighten the nut, then loosen one half turn.

t. Position the woodruff key (44) in the slotted motor shaft.

u. Seat the motor pulley (43) to the rear of the motor shaft.

v. Install the 1/2-inch nut (42) on the motor shaft and, while holding the pulley with a 3/4 inch open end wrench, tighten the nut to 120 inch-pounds.

w. Install the spring tension assembly (refer to paragraph 5-22).

x. Install the drive belt and adjust the belt tension as outlined in paragraph 5-21.

y. Make sure all hardware is tightened securely.

To reassemble, reverse the procedures in steps g through c. Tighten the screws removed in steps d, f, and h as follows:

Step	SCREW	Torque Setting (inch-pounds)
d	T7 (28)	5
f	T15 (39, 41)	20
h	T25 (46)	50

5-24. MOTOR PULLEY (43, figure 6-3)

Two different pulleys are used to control the speed of the spindle. One pulley/drive belt combination is used for 50 Hz operation and another pulley/drive belt combination is used for 60 Hz operation. To change the pulley/drive belt combination, proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Remove the following items:

- Drive belt cover (refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives)
- Drive belt (refer to paragraph 5-21)

d. Using a 3/4-inch open end wrench to hold the motor pulley (43), remove the 1/2-inch nut (42) on the motor shaft.

CAUTION

When the motor pulley is removed from the motor shaft, the woodruff key will fall free. Do not allow the key to fall into the spindle motor area.

e. Slide the pulley off the motor shaft, being careful not to lose the woodruff key (44).

f. Verify that the pulley/drive belt combination to be installed is correct for the power line frequency available.

Frequency	Pulley No.	Drive Belt No.
50 Hz	07912-20013	07912-40018
60 Hz	07912-20024	07912-40017

Note: The outside diameter measurement of the 60 Hz motor pulley is 59.3 mm (2.33 in.); the outside diameter measurement of the 50 Hz motor pulley is 71.2 mm (2.8 in.).

g. Position the woodruff key (44) in the slotted motor shaft.

h. Seat the pulley to the rear of the motor shaft.

i. Install the 1/2-inch nut (42) on the motor shaft and, while holding the pulley with a 3/4-inch open end wrench, tighten the nut to 120 inch-pounds.

j. Install the drive belt and adjust the belt tension as outlined in paragraph 5-21.

k. Change the power specification label to reflect the frequency for which the drive is currently configured.

l. Install the drive belt cover. (Refer to paragraph 5-17 for stand-alone drives; refer to paragraph 5-49 for rackmount drives.)

5-25. HP-IB PCA-A14 (6, figure 6-4)

The HP-IB PCA-A14 is mounted on the inside of the power supply door. To remove the PCA, proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Disconnect the HP-IB cable(s) (35, 36, figure 6-1; or 17, 18, figure 6-2) from the PCA edge connector(s).

e. Remove the four hex standoffs (7, figure 6-4) that attach the HP-IB PCA-A14 (6) to the power supply door (8).

To install the PCA, reverse the above procedure.

Note: If a new HP-IB PCA-A14 is being installed, set the HP-IB address switches to correspond to the settings on the old PCA.

5-26. POWER REGULATOR PCA-A13 (1, figure 6-4)

The power regulator PCA-A13 (1) is mounted on the inside of the power supply door. To remove the PCA, proceed as follows:

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Disconnect the six cables from the power regulator PCA-A13.

e. Remove the seven T15 screws that mount the PCA to the power supply door (see figure 5-5).

Note: During assembly, when the cables are connected to the power regulator PCA-A13, the ribbon cable should be routed beneath the other two cables to prevent pinching the cable in the power supply door.

To install, reverse the above procedure. Tighten the screws removed in step e to 15 inch-pounds.

5-27. POWER SWITCH AND FUSE ASSEMBLY (11, figure 6-4)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the two T15 screws (40) which mount the shield (39) to the terminal block TB1(43).

e. From terminal block TB1, remove the T10 screw (42) which connects the brown wire from the fuse holder.

f. Remove the two T15 screws (12) that mount the power switch and fuse assembly (11) to the power supply chassis.

g. Cut the cable tie located directly behind the power switch and fuse assembly.

h. From the power switch and fuse assembly, disconnect the two wires (blue and brown) that attach to the line filter (16) and the blue wire that attaches to terminal block TB1 (43).

CAUTION

When installing the power switch and fuse assembly, consult service sheet 6 to ensure that all wires are connected properly.

To install, reverse the above procedure. Tighten the screws removed in steps d, e, and f as follows:

Step	Screw	Torque Setting (inch-pounds)
d	T15 (40)	20
e	T10 (42)	15
f	T15 (12)	20

5-28. LINE FILTER (16, figure 6-4)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the two T15 screws (12) that mount the power switch and fuse assembly (11) to the power supply chassis.

e. Cut the cable tie located between the line filter (16) and the power switch and fuse assembly (11).

f. From the power switch, disconnect the two wires (blue and brown) that attach to the line filter.

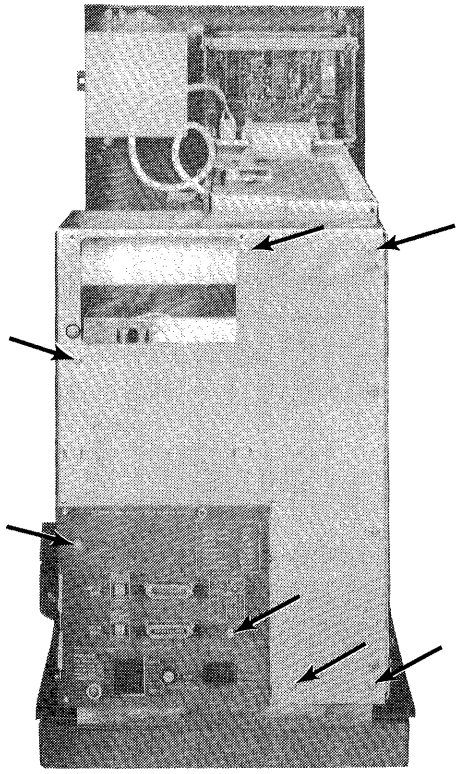
g. Remove the two T15 screws (17) that mount the line filter (16) to the power supply chassis.

CAUTION

When installing the line filter, consult service sheet 6 to ensure that all wires are connected properly.

To install, reverse the above procedure. Tighten the screws removed in steps d and g as follows:

Step	Screw	Torque Setting (inch-pounds)
d	T15 (12)	20
g	T15 (17)	20



MOUNTING SCREW POSITIONS INDICATED BY ARROWS

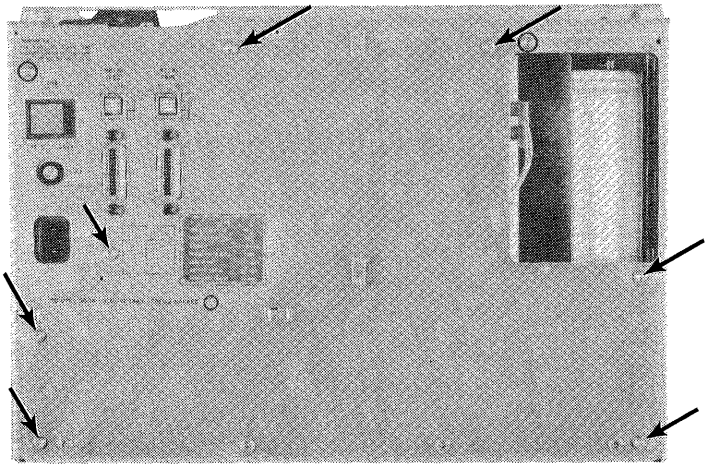


Figure 5-5. Power Regulator PCA Mounting Screws

5-29. POWER CAPACITOR ASSEMBLY
(22 through 32, figure 6-4)

The power capacitor assembly and the rectifier diode assembly (34) are removed and installed as a single unit.

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Disconnect connectors A13P600 and A13P620 from power regulator PCA-A13.

e. Open the three cable clips (19).

f. From the fuse holder mounted on the power capacitor cover (24), disconnect the two yellow wires attached to the power transformer (53).

CAUTION

Before connecting the white wires to the diode assembly during replacement, examine the insulating washers for wear or damage. A short-circuit through the washers may result in damage to the drive.

Note: Before removal, note the arrangement of the hardware which secures the white wires to the diode assembly.

g. From the diode assembly (34), disconnect the two white wires attached to the power transformer (53).

h. Remove the two T15 screws (35) attaching the diode assembly (34) to the power supply chassis.

i. Remove the two power capacitor assembly T25 mounting screws (21) located inside the power supply chassis.

j. Supporting the power capacitor assembly with one hand, remove the third T25 mounting screw (21) located on the outside of the power supply chassis.

k. From the power capacitor assembly, remove the two T25 screws (26) which connect the two wires (red and black) attached to the power transformer (53).

l. Remove the power capacitor assembly and the diode assembly as a single unit.

To install, reverse the above procedure. Tighten the screws removed in steps h through k as follows:

Step	Screw	Torque Setting (inch-pounds)
h	T15 (35)	20
i	T25 (21)	25
j	T25 (21)	25
k	T25 (26)	10

5-30. BLEEDER RESISTOR ASSEMBLIES (28, figure 6-4)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the power capacitor assembly. (Refer to paragraph 5-29.)

e. Remove the two T25 screws (26) that attach the bleeder resistor (28) to the capacitor.

CAUTION

When installing a bleeder resistor assembly, consult service sheet 6 to ensure that all wires are connected properly.

To install, reverse the above procedure. Tighten the T25 screws removed in step e to 10 inch-pounds.

5-31. POWER CAPACITORS
(29, 30, 31, figure 6-4)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the power capacitor assembly (refer to paragraph 5-29).

e. Remove the two T25 screws (26) which secure the bleeder resistor assembly (28) to the capacitor to be removed (refer to paragraph 5-30).

f. Remove the two T15 screws (25) which secure the power capacitor cover (24).

g. Remove the capacitor.

CAUTION

When installing a power capacitor, consult service sheet 6 to ensure that all wires are connected properly.

To install, reverse the above procedure. Tighten the screws removed in steps e and f as follows:

Step	Screw	Torque Setting (inch-pounds)
e	T25 (26)	10
f	T15 (25)	20

5-32. BRIDGE RECTIFIER

(22, figure 6-4)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Disconnect the four wires from the bridge rectifier (22).

e. Remove the T15 screw (23) mounting the bridge rectifier (22) to the power capacitor assembly chassis (32).

CAUTION

When installing the bridge rectifier, consult service sheet 6 to ensure that all wires are connected properly.

Installation is essentially the reverse of the above procedure; however, before installing the bridge rectifier, apply a thin coating of thermal grease (HP part no. 6040-0239) to it. Tighten the T15 screw (23) removed in step e to 20 inch-pounds.

5-33. DIODE ASSEMBLY (34, figure 6-4)

The diode assembly (34) and the power capacitor assembly (22 through 32) are removed as a single unit. To remove, proceed as follows:

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the power capacitor assembly (refer to paragraph 5-29).

e. From capacitor C1 (29), remove the T25 screw (26) to disconnect the red wire that attaches to the diode assembly.

CAUTION

When installing the diode assembly, consult service sheet 6 to ensure that all wires are connected properly.

To install, reverse the above procedure. Tighten the T25 screw (26) removed in step e to 10 inch-pounds.

5-34. MOTOR CONTROL ASSEMBLY

(37, figure 6-4)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the two T15 screws (40) which secure the shield (39) to terminal block TB1 (43).

e. From terminal block TB1, remove the T10 screws (42) to disconnect the two wires (blue and yellow) that attach to the motor control assembly (37).

f. Remove the four pin connector (W13J1) from the rear panel of the power supply.

g. Disconnect the two wires (yellow and red) from the relay connectors at the top of the motor control assembly.

Note: When connecting these wires, the red wire must connect to pin 3 (+3) of the relay.

h. Remove the three T15 screws (38) that mount the motor control assembly to the power supply chassis (55).

CAUTION

When installing the motor control assembly, consult service sheet 6 to ensure that all wires are connected properly.

To install, reverse the above procedure. Tighten the screws removed in steps d, e, and h as follows:

Step	Screw	Torque Setting (inch-pounds)
d	T15 (40)	20
e	T10 (42)	15
h	T15 (38)	20

5-35. TERMINAL BLOCK TB1
(43, figure 6-4)

a. Perform preparation procedures (refer to paragraph 5-2).

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the two T15 screws (40) which secure the shield (39) to terminal block TB1 (43).

e. Remove the T10 screws (42) and disconnect all wires from TB1.

f. Remove the two T30 screws (48) that mount the terminal block and the marker strip (44) to the power transformer (53).

CAUTION

When installing terminal block TB1, consult service sheet 6 to ensure that all wires are connected properly.

Note: When installing the marker strip (44), ensure that the number 7 (seven) is in the upper right-hand corner of the terminal block.

To install, reverse the above procedure. Tighten the screws removed in steps d, e, and f as follows:

Step	Screw	Torque Setting (inch-pounds)
d	T15 (40)	20
e	T10 (42)	15
f	T30 (48)	36

5-36. POWER TRANSFORMER
(53, figure 6-4)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power. Install the anti-tip feet (on rackmount drives only).

c. Gain access to the power supply. (Refer to paragraph 5-11 for stand-alone drives; refer to paragraph 5-43 for rackmount drives.)

d. Remove the power switch and fuse assembly. (Refer to paragraph 5-27.)

e. Remove the line filter. (Refer to paragraph 5-28.)

f. Remove the power capacitor assembly. (Refer to paragraph 5-29.)

g. Remove the two T15 screws (40) which secure the shield (39) to terminal block TB1 (43).

h. From terminal block TB1 (43), remove the T10 screws (42) to disconnect the six wires attached to the power transformer (53).

i. Remove the T15 screw (51) which secures the power transformer ground wire (green/yellow) to the bottom of the power supply chassis (55).

j. Remove the four T30 screws (48) that mount the power transformer to the power supply chassis.

CAUTION

When installing the power transformer, consult service sheet 6 to ensure that all wires are connected properly.

To install, reverse the above procedure. Tighten the screws removed in steps h, i, and j as follows:

Step	Screw	Torque Setting (inch-pounds)
h	T10 (42)	15
i	T15 (51)	20
j	T30 (48)	36

5-37. CASTER (53, figure 6-1)

a. Perform the preparation procedures outlined in paragraph 5-2.

b. Disconnect the ac power cord from the ac mains power.

c. Place the disc drive on its right side (the storage box toward the floor).

d. Using a large, flat-blade screwdriver, pry the defective caster away from its mounting bracket. The plastic washer which fits between the caster wheel and the bracket must be reused.

e. Tap the new caster into place using the palm of the hand.

5-38. REMOVAL AND REPLACEMENT (RACKMOUNT DRIVE)

The following removal and replacement procedures are unique to the rackmount drives.

5-39. FRONT PANEL (2, figure 6-2)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel (2) by pulling it forward.

To install, push the panel into place.

If the front panel does not fit properly in place, one or more stud retainers may need replacement. The defective stud retainer must be drilled out with a 0.125 inch bit (3.2 mm) from the front of the disc module. The new stud retainer is held in place by two screws as shown in figure 6-2, detail A.

5-40. SWITCH PCA-A15 (7, figure 6-2)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel. (Refer to paragraph 5-39.)

d. Remove the two T15 screws (4) that attach the shield (5) and the switch PCA-A15 (7) to the tape module (10).

e. Remove the switch cable (6) from the switch PCA-A15.

To replace, reverse the above procedure. Tighten the T15 screws removed in step d to 10 inch-pounds.

5-41. TAPE MODULE (10, figure 6-2)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel. (Refer to paragraph 5-39.)

d. Remove the switch PCA-A15. (Refer to paragraph 5-40.)

e. Loosen, but do not remove, the two screws (10A) which secure the ground straps (10B) to the tape module (10).

f. Pull the two ground straps (10B) free.

g. Remove the three T15 screws (11) that attach the tape module (10) to the rackmount chassis (29).

h. Pull the tape module forward until the tape data cable (8) and the tape power cable (9) are accessible.

i. Remove the tape power cable and tape data cable from the rear of the tape module.

j. Remove the tape module.

To replace, reverse the above procedure. Tighten the T15 screws removed in step g to 10 inch-pounds.

5-42. CARD CAGE ACCESS

Removal of the card cage shield assembly (1, figure 6-3) provides access to a majority of the printed circuit assemblies (PCA's). To gain access, proceed as follows:

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power.

c. Remove the front panel. (Refer to paragraph 5-39.)

d. Loosen the two captive screws that hold the card cage shield assembly (1) to the card cage.

e. Remove the shield from the front of the card cage.

WARNING

The card cage shield assembly captive screws must be tightened to 15 inch-pounds to prevent operator access to the card cage.

To replace the card cage cover, reverse the above procedure.

5-43. POWER SUPPLY ASSEMBLY (figure 6-4)

To remove, repair or replace the power supply, proceed as follows:

Note: If it is necessary to only gain access to the interior of the power supply, skip steps f through i.

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power and install the anti-tip feet.

c. Remove the two T15 screws (9, figure 6-4) that hold the power supply door (8) closed (see figure 5-6).

d. Disconnect the cable(s) from the HP-IB PCA-A14 and swing the hinged door open.

e. Open the two cable clips (19, figure 6-4) and pull the two-wire brake cable free.

f. Disconnect all cables connected to the power supply assembly from external assemblies.

Note: During assembly, when the cables are connected to the power regulator PCA-A13, the ribbon cable should be routed beneath the other two cables to prevent pinching the cable in the power supply door.

g. Remove the T30 screw (15, figure 6-2) that attaches the ground strap (14) to the power supply chassis.

h. Remove the T25 screw (20), washer (21), and power supply mounting clamp (22) from the upper right-hand corner of the power supply chassis.

i. Remove the T25 power supply mounting screw (23) located inside the power supply chassis.

j. Remove the two T30 transformer screws (48, figure 6-4) used to attach the power supply to the rackmount chassis (29, figure 6-2).

k. Pull the power supply out and up to remove it from the support pin on the rackmount chassis.

To install, reverse the above procedure. Tighten the screws removed in steps c, g, h, i, and j as follows:

Step	Screw	Torque Setting (inch-pounds)
c	T15 (9)	25
g	T30 (15)	60
h	T25 (20)	40
i	T25 (23)	40
j	T30 (48)	36

5-44. SHIPPING LOCKS (figure 5-2)

The drives are shipped with the disc spindle and the actuator locked to prevent damage to the disc mechanism. Before operating the drive, the shipping locks must be set to the OPERATE position. To unlock the spindle and actuator, proceed as follows:

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power and install the anti-tip feet.

c. Loosen the T15 screw that holds the spindle lock in place.

d. Using a flat blade screwdriver, pry the spindle lock to the OPERATE position. Tighten the T15 screw to 20 inch-pounds.

e. Turn the actuator lock to the OPERATE position.

To lock the disc mechanism, perform the above procedure but move the locks to the SHIP position.

Note: When locking the spindle, ensure that the spindle lock is wedged tightly under the spindle pulley.

5-45. DISC MODULE (25, figure 6-2)

WARNING

The disc module weighs 34 kg (75 lb). Two people are required to lift it.

CAUTION

Bumping or dropping the disc module can cause damage to the heads and/or media. This damage can occur even with the shipping locks engaged. To avoid damage, use great care when handling the disc module.

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power and install the anti-tip feet.

c. Remove the following items:

- Front panel (refer to paragraph 5-39)
- Tape module (refer to paragraph 5-41)
- Card cage shield and all PCA's (refer to paragraph 5-42)
- Power supply (refer to paragraph 5-43)

d. Set the shipping locks to the SHIP position. (Refer to paragraph 5-44.)

e. Remove the six T20 screws (31, 34) which secure the rackmount chassis (29) to the rack slides (30, 33).

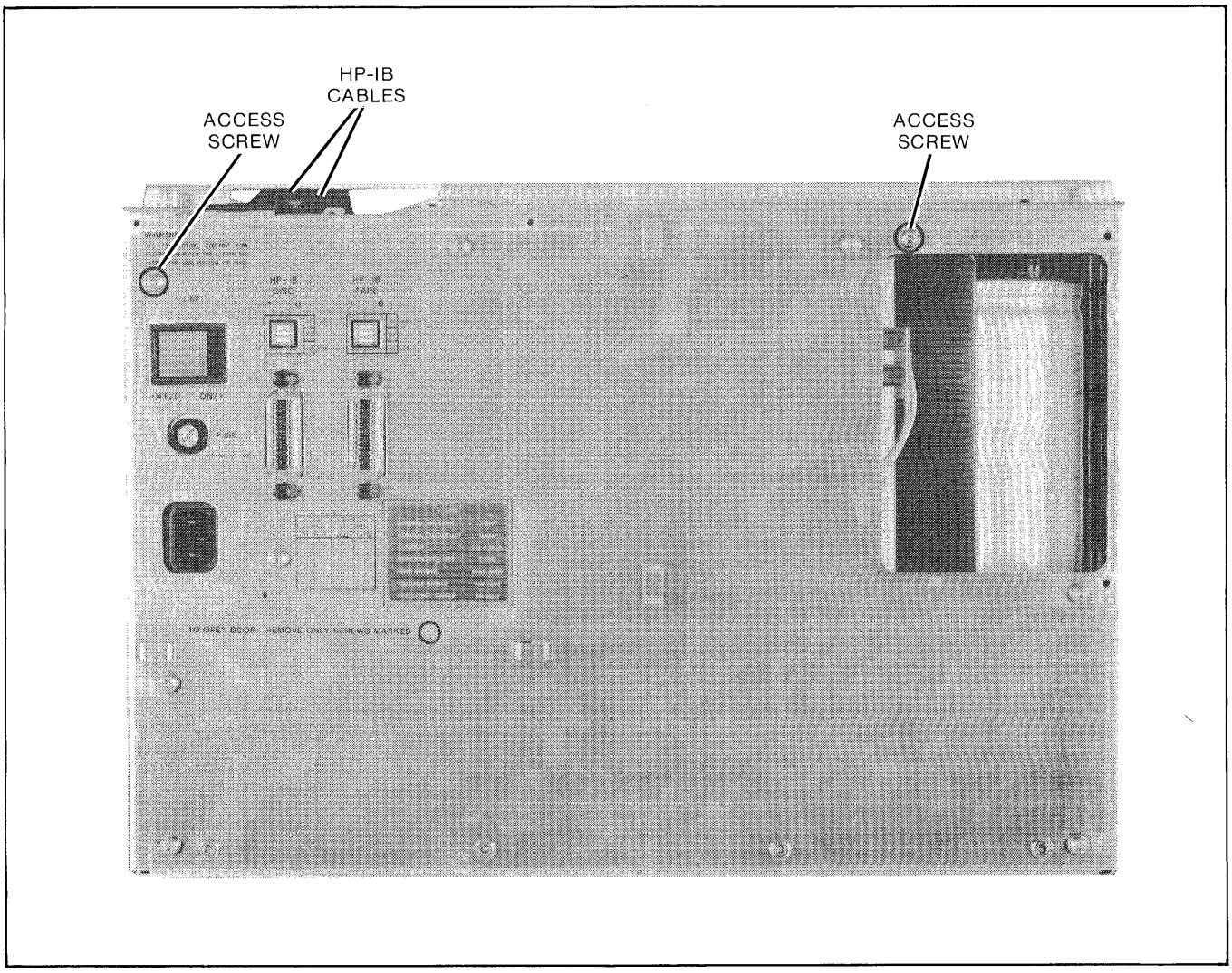


Figure 5-6. Rackmount Drive Power Supply Access Screws

f. Using two people, remove the drive from the rack slides.

g. Disconnect all cables connected to the disc module.

h. Remove the T30 screw (15) that attaches the ground strap (14) to the disc mechanism.

i. Remove the socket head cap screw (10C) that attaches the two ground straps (10B) to the disc mechanism.

j. Remove the six T30 screws (24) that attach the disc module (25) to the rackmount chassis (29).

k. Lift the rackmount chassis off the disc module and install on the new module. Tighten the T30 screws (24) to 60 inch-pounds.

l. Remove the following cables and install them on the new disc module:

- Tape power cable (9)
- Tape data cable (8)
- Switch PCA-A15 cable (6)
- HP-IB cable(s) (17, 18)

m. Attach the ground strap (14) to the disc module using the T30 mounting screw (15). Tighten this screw to 60 inch-pounds.

n. Attach the two ground straps (10B) to the disc mechanism using the socket head cap screw (10C).

o. Connect all cables to the disc module.

WARNING

Ensure that the front pins on the slides engage the holes in the rackmount chassis. The drive may fall if the pins are not engaged properly.

p. Using two people, lift the drive onto the rack slides (30, 33) and engage the front pins in the holes on the rackmount chassis.

q. Secure the rack slides (30, 33) to the rackmount chassis (29) using the six T20 screws (31,34). Tighten these screws to 20 inch-pounds.

r. Set the two shipping locks to the OPERATE position. (Refer to paragraph 5-44.)

s. Install the following items:

- Power supply (refer to paragraph 5-43)
- Card cage cover and all PCA's (refer to paragraph 5-42)
- Tape module (refer to paragraph 5-41)
- Front panel (refer to paragraph 5-39)

5-46. SHOCK MOUNTS (28, figure 6-2)

To replace the shock mounts, proceed as follows:

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power and install the anti-tip feet.

c. Remove the following items:

- Front panel (refer to paragraph 5-39)
- Tape module (refer to paragraph 5-41)
- Power supply assembly (refer to paragraph 5-43)
- Disc module (refer to paragraph 5-45)

d. Remove the 1/2-inch nuts (26) that attach the shock mounts (28) to the rackmount chassis (29).

e. Remove the ground straps (28A) from each of the shock mounts and install the straps on the new shock mounts.

f. Using the 1/2-inch nuts (26), install new shock mounts on the chassis. Tighten these nuts to 60 inch-pounds.

g. Install the rackmount chassis on the disc module using the six T30 mounting screws (24). Tighten these screws to 60 inch-pounds.

To reassemble, install the items removed in step c.

5-47. DISC MECHANISM COVER (14, figure 6-3)

The disc mechanism cover must be removed to remove or repair the following items:

- Speed sensor
- Motor
- Motherboard PCA

To remove the disc mechanism cover proceed as follows:

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power and install the anti-tip feet.

c. Remove the nine T20 screws (15) that hold the cover (14) on the disc mechanism.

Note: To simplify removal, avoid catching the cover on the edge of the disc mechanism directly under the tape module.

d. Pull the cover away from the disc mechanism.

To reassemble reverse the above procedure. Tighten the screws removed in step c to 15 inch-pounds.

5-48. MOTHERBOARD PCA-A11 (26, figure 6-3)

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power and install the anti-tip feet.

c. Remove the following items:

- Front panel (refer to paragraph 5-39)
- Card cage cover and all PCA's (refer to paragraph 5-42)
- Disc mechanism cover (refer to paragraph 5-47)

d. Unplug all cables from motherboard PCA-A11.

e. Remove the two T20 screws (17, 21) that attach the mounting brackets (16, 20) to the disc mechanism and remove the small bracket.

f. Remove the motherboard PCA-A11.

Note: The motherboard PCA-A11 fits tight in the slots. Hold the board at the center, or pull equally at the top and bottom, to prevent the board from jamming in the slots.

g. Remove the screw (19) that attaches the large bracket (16) to the motherboard.

h. Remove the large bracket.

Installation of the motherboard PCA-A11 is the reverse of this procedure. Tighten the T20 screws removed in step e to 20 inch-pounds.

5-49. DRIVE BELT COVER

(31, figure 6-3)

Removal of the drive belt cover provides access to the following items:

- Drive belt
- Pulleys
- Spring tensioning system
- Motor
- Spindle pulley lock
- Speed sensor

a. Perform preparation procedures. (Refer to paragraph 5-2.)

b. Disconnect the ac power cord from the ac mains power and install the anti-tip feet.

c. Remove the four T15 screws (32) that attach the drive belt cover to the disc mechanism (11).

To replace the drive belt cover, proceed as follows:

CAUTION

Ensure that the grounding strip on the drive belt cover is rotated so the hole in the strip is aligned with the nearest hole in the drive belt cover. Failure to do this may damage the grounding strip and cause loss of data.

a. Place the cover on the disc mechanism and install a T15 screw (32) in the hole aligned with the grounding strip. Tighten this screw finger tight.

b. Install the other three T15 screws (32) and tighten all four screws to 20 inch-pounds.

REPLACEABLE PARTS

SECTION VI

6-1. INTRODUCTION

This section provides listings of all field-replaceable parts and an illustrated parts breakdown for the drives, as well as replaceable part ordering information.

Replaceable parts for the drives are listed in disassembly order in tables 6-1 through 6-4 and illustrated in figures 6-1 through 6-4. In each table, attaching parts are listed immediately after the item they attach. Items in the DESCRIPTION column are indented to indicate relationship to the next higher assembly. In addition, the symbol "— — — x — — —" follows the last attaching part for that item. Indentation of the items in the tables is as follows:

Major Assembly

*Replaceable Assembly

*Attaching Parts for Replaceable Assembly

**Subassembly or Component Part

**Attaching Parts for Subassembly or Component Part

***Sub-subassembly or Component Part

***Attaching Parts for Sub-subassembly or Component Part

The replaceable parts listings provide the following information for each part. Refer to table 6-5 for an explanation of abbreviations used in the replaceable parts tables.

a. FIG. & INDEX NO. The figure and index number which indicates where the replaceable part is illustrated.

b. HP PART NO. The Hewlett-Packard part number for each replaceable part.

c. DESCRIPTION. The description of each replaceable part.

d. MFR CODE. The 5-digit code that denotes a typical manufacturer of a part. Refer to table 6-6 for a listing of manufacturers that correspond to the codes.

e. MFR PART NO. The manufacturer's part number of each replaceable part.

f. UNITS PER ASSY. The total quantity of each part used in the major assembly.

The MFR CODE and MFR PART NO. for common hardware items are listed as 00000 and OBD (order by description), respectively, because these items can usually be purchased locally.

TORX® hardware is used in the assembly of the drive. This hardware requires the use of special drivers (refer to table 4-1). In this manual, any reference to this type of hardware will be accompanied by the appropriate driver size (for example, T15).

6-2. ORDERING INFORMATION

To order replaceable parts for the drive, address the order to your local Hewlett-Packard Sales and Support Office. Sales and Support Offices are listed at the back of this manual. Specify the following information for each part ordered:

a. Model and full serial number.

b. Hewlett-Packard part number.

c. Complete description for each part as provided in the replaceable parts listing.

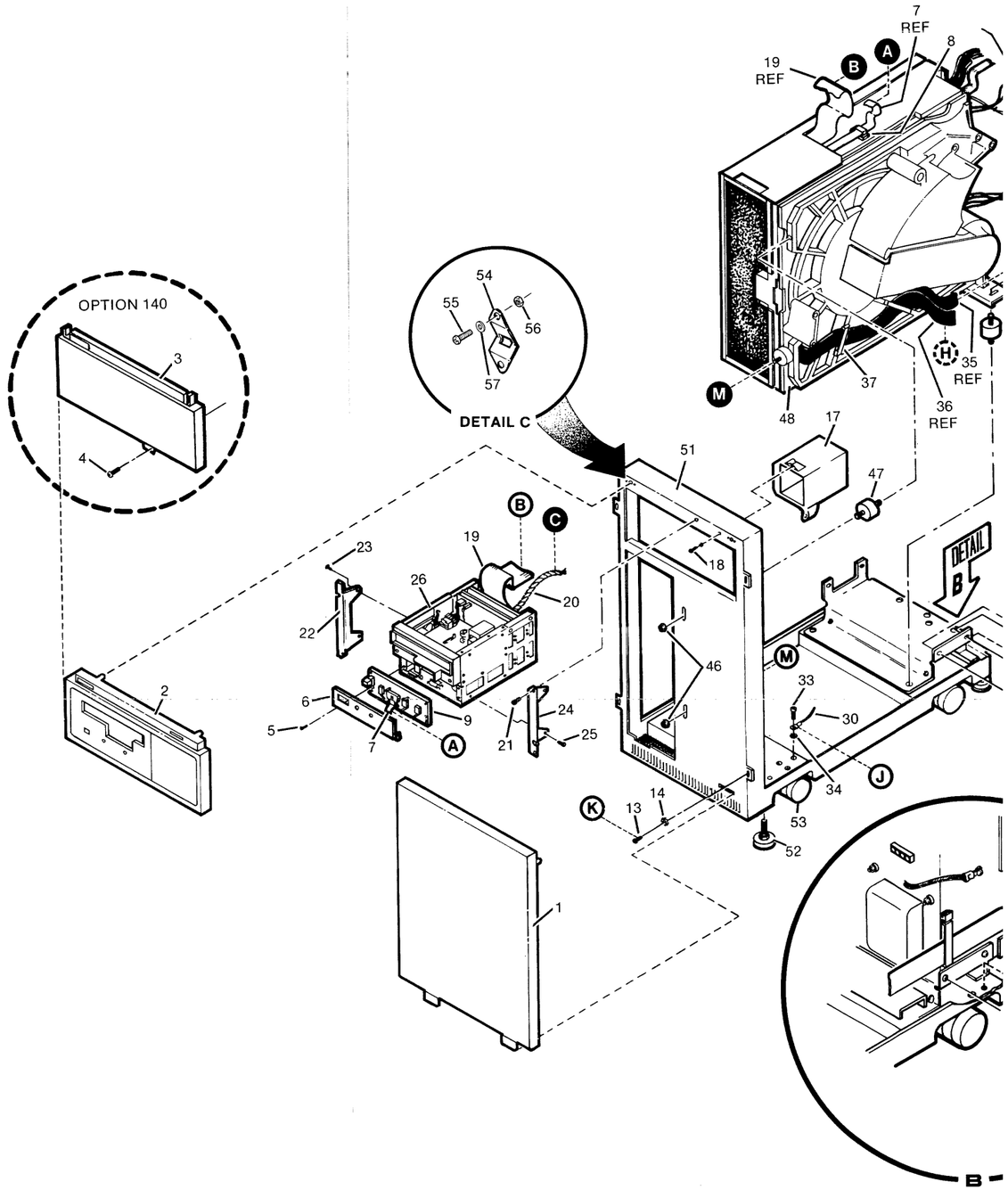
TORX® is a registered trademark of the Camcar Division of Textron, Inc.

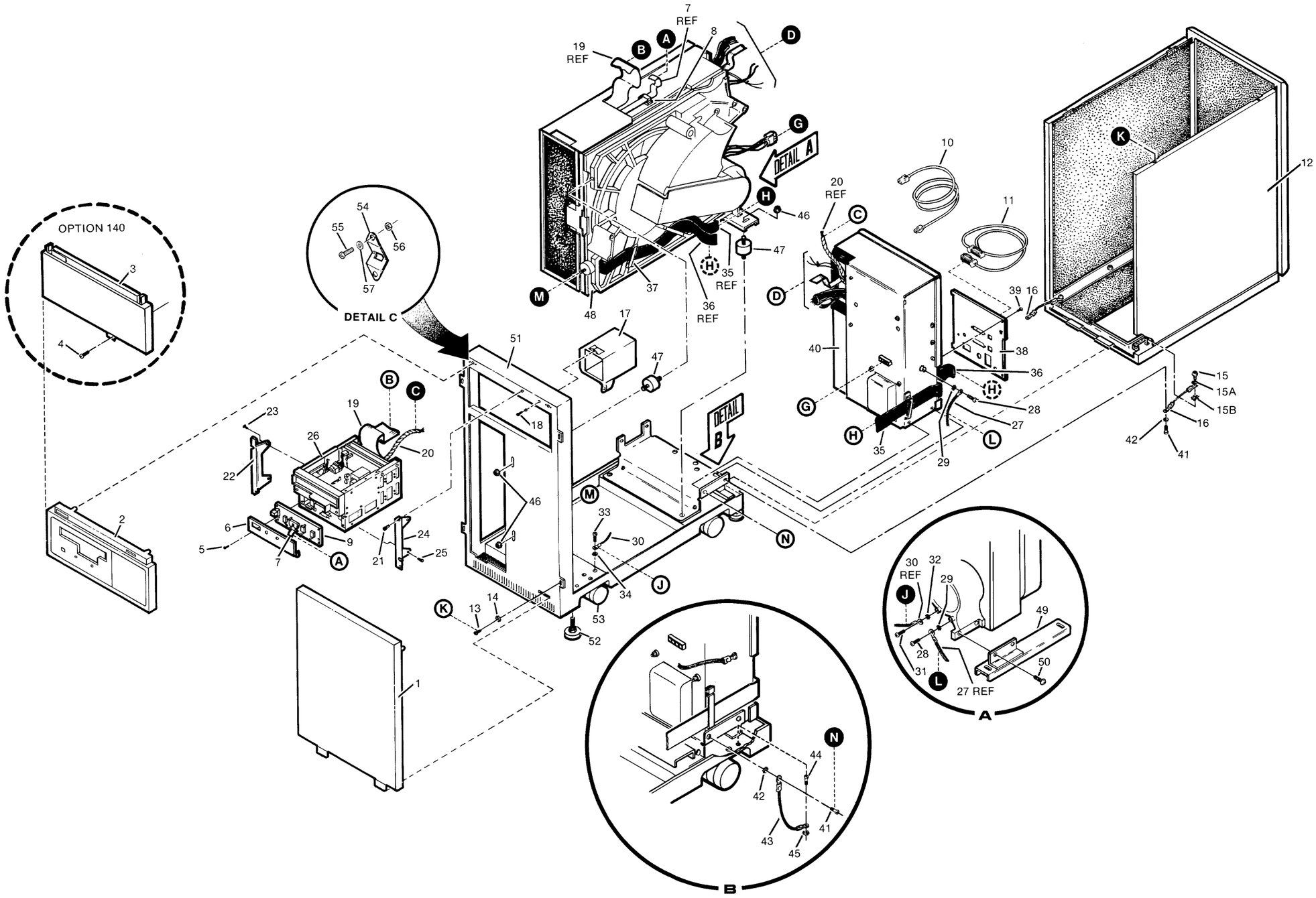
Table 6-1. Stand-Alone Drives, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1-	7911P	DISC/TAPE DRIVE, stand-alone cabinet	28480	7911P	REF
	7912P	DISC/TAPE DRIVE, stand-alone cabinet	28480	7912P	REF
	7914P	DISC/TAPE DRIVE, stand-alone cabinet	28480	7914P	REF
1	07908-60034	*PANEL, lower front	28480	07908-60034	1
2	07911-60024	*PANEL, upper front (7911P only)	28480	07911-60024	1
	07912-60024	*PANEL, upper front (7912P only)	28480	07912-60024	REF
	07914-60024	*PANEL, upper front (7914P only)	28480	07914-60024	REF
3	07911-60025	*FILLER PANEL, upper front (7911P, Option 140)	28480	07911-60025	1
	07912-60025	*FILLER PANEL, upper front (7912P, Option 140)	28480	07912-60025	REF
	07914-60025	*FILLER PANEL, upper front (7914P, Option 140)	28480	07914-60025	REF
		(Attaching Parts)			
4	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	1
		— — — x — — —			
5	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	2
6	07908-00047	*ELECTROSTATIC DISCHARGE SHIELD	28480	07908-00047	1
7	07908-60144	*CABLE, switch (W11)	28480	07908-60144	1
		(Attaching Parts)			
8	1400-0698	*CLAMP, flat cable, nylon, adhesive, 0.75 in. by 1.75 in.	00000	OBD	1
		— — — x — — —			
9	07908-60142	*SWITCH PCA-A15	28480	07908-60142	1
10	8120-2371	*POWER CORD, 16 AWG	28480	8120-2371	1
	8120-1351	*POWER CORD, BS 1363/CEE	28480	8120-1351	REF
	8120-1369	*POWER CORD ASC 112/CEE	28480	8120-1369	REF
	8120-1689	*POWER CORD, GMBH/CEE	28480	8120-1689	REF
	8120-1860	*POWER CORD, CEE/CEE	28480	8120-1860	REF
	8120-2104	*POWER CORD, SEV/CEE	28480	8120-2104	REF
	8120-2956	*POWER CORD, MDPP/CEE	28480	8120-2956	REF
11	8120-3445	*CABLE, HP-IB, 1 metre (Model 10833A)	28480	8120-3445	1
12	07912-60066	*FLIP-TOP ASSEMBLY	28480	07912-60066	1
		(Attaching Parts)			
13	0515-0380	*SCREW, machine, pnh, torque T15, M4.0 by 0.7, 10 mm long, w/square cone washer	00000	OBD	4
14	2190-0413	*WASHER, lock, ext. tooth, 0.168 in. ID	00000	OBD	4
15	0515-0360	*SCREW, tapping, hex-washer head, 6.3 by 1.81, 12 mm long	00000	OBD	2
15A	3050-1013	*WASHER, flat, 6.0 mm	00000	OBD	2
15B	2190-0070	*WASHER, lock, ext-tooth, 0.25 in. ID	00000	OBD	2
16	07912-60101	*GROUND STRAP	28480	07912-60101	2
		— — — x — — —			
17	07908-40004	*STORAGE BOX	28480	07908-40004	1
		(Attaching Parts)			
18	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	3
		— — — x — — —			
19	07912-60048	*CABLE, tape data (W10)	28480	07912-60048	1
20	07912-60047	*CABLE, tape power (W6)	28480	07912-60047	1
21	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	5
22	07908-00035	*BRACKET, tape module, left	28480	07908-00035	1
		(Attaching Parts)			
23	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	2
		— — — x — — —			
24	07908-00036	*BRACKET, tape module, right	28480	07908-00036	1
		(Attaching Parts)			
25	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	2
		— — — x — — —			
26	07908-60340	*TAPE MODULE	28480	07908-60340	1

Table 6-1. Stand-Alone Drives, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-1-27	07912-60074	*GROUND STRAP	28480	07912-60074	1
		(Attaching Parts)			
28	0515-0441	*SCREW, machine, pnh, torque T30, M6.0 by 1.0, 12 mm long, w/square cone washer	00000	OBD	2
29	2190-0070	*WASHER, lock, ext-tooth, 0.256 in. ID	00000	OBD	2
		— — — x — — —			
30	07912-60077	*GROUND STRAP	28480	07912-60077	1
		(Attaching Parts)			
31	0515-0441	*SCREW, machine, pnh, torque T30, M6.0 by 1.0, 12 mm long, w/square cone washer	00000	OBD	1
32	2190-0070	*WASHER, lock, ext-tooth, 0.256 in. ID	00000	OBD	1
33	3020-0017	*SCREW, socket cap, 0.500 in. long, 5/16 thread	00000	OBD	1
34	2190-0025	*WASHER, lock, ext-tooth	00000	OBD	1
		— — — x — — —			
35	07912-60046	*CABLE, HP-IB, DMA (W1)	28480	07912-60046	1
36	07912-60046	*CABLE, tape, HP-IB, DMA (W2, Option 001)	28480	07912-60046	1
		(Attaching Parts)			
37	1400-0694	*CLAMP, flat cable, nylon, adhesive, 0.75 in. by 3.0 in.	00000	OBD	4
		— — — x — — —			
38	07912-00065	*PLATE, label	28480	07912-00065	1
		(Attaching Parts)			
39	0515-0430	*SCREW, machine, pnh, torque T30, M3.0 by 0.5, 6 mm long, w/square cone washer	00000	OBD	1
		— — — x — — —			
40	07912-60028	*POWER SUPPLY ASSEMBLY (see figure 6-4)	28480	07912-60028	1
		(Attaching Parts)			
41	0515-0439	*SCREWM machine, pnh, torque T25, M5.0 by 0.8, 10 mm long, w/flat washer	00000	OBD	4
42	2190-0467	*WASHER, lock, ext-tooth, 0.195 in. ID	00000	OBD	3
43	07912-60102	*GROUND STRAP	28480	07912-60102	1
44	0515-0390	*SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer	00000	OBD	1
45	2190-0413	*WASHER, lock, ext-tooth, 0.168 in. ID	00000	OBD	1
		— — — x — — —			
46	2950-0169	*NUT, hex, flange lock, 5/16-18 thd, 0.50 in.	00000	OBD	4
47	1520-0210	*SHOCK MOUNT, rubber, 1.0 in. long, threaded shank	81860	A 43-051	4
48	No Number	*DISC MODULE (see figure 6-3)	28480	NSR	1
49	07912-00036	*BRACKET, mounting, disc module	28480	07912-00036	1
		(Attaching Parts)			
50	0515-0442	*SCREW, machine, pnh, torque T30, M6.0 by 1.0, 16 mm long, w/square cone washer	00000	OBD	2
		— — — x — — —			
51	07912-60067	*CABINET BASE ASSEMBLY	28480	07912-60067	1
52	0403-0412	**LEVELING PAD	28480	0403-0412	4
53	1492-0083	**CASTER	28480	1492-0083	4
54	1390-0681	**STUD RETAINER	28480	1390-0681	5
		(Attaching Parts)			
55	2200-0598	**SCREW, machine, pnh, pozi, no. 4, 0.312 in. long	00000	OBD	2
56	2260-0001	**NUT, hex, 4-40	00000	OBD	2
57	2190-0411	**WASHER, lock, ext-tooth, no. 4	00000	OBD	2
		— — — x — — —			





REF 7912-35B

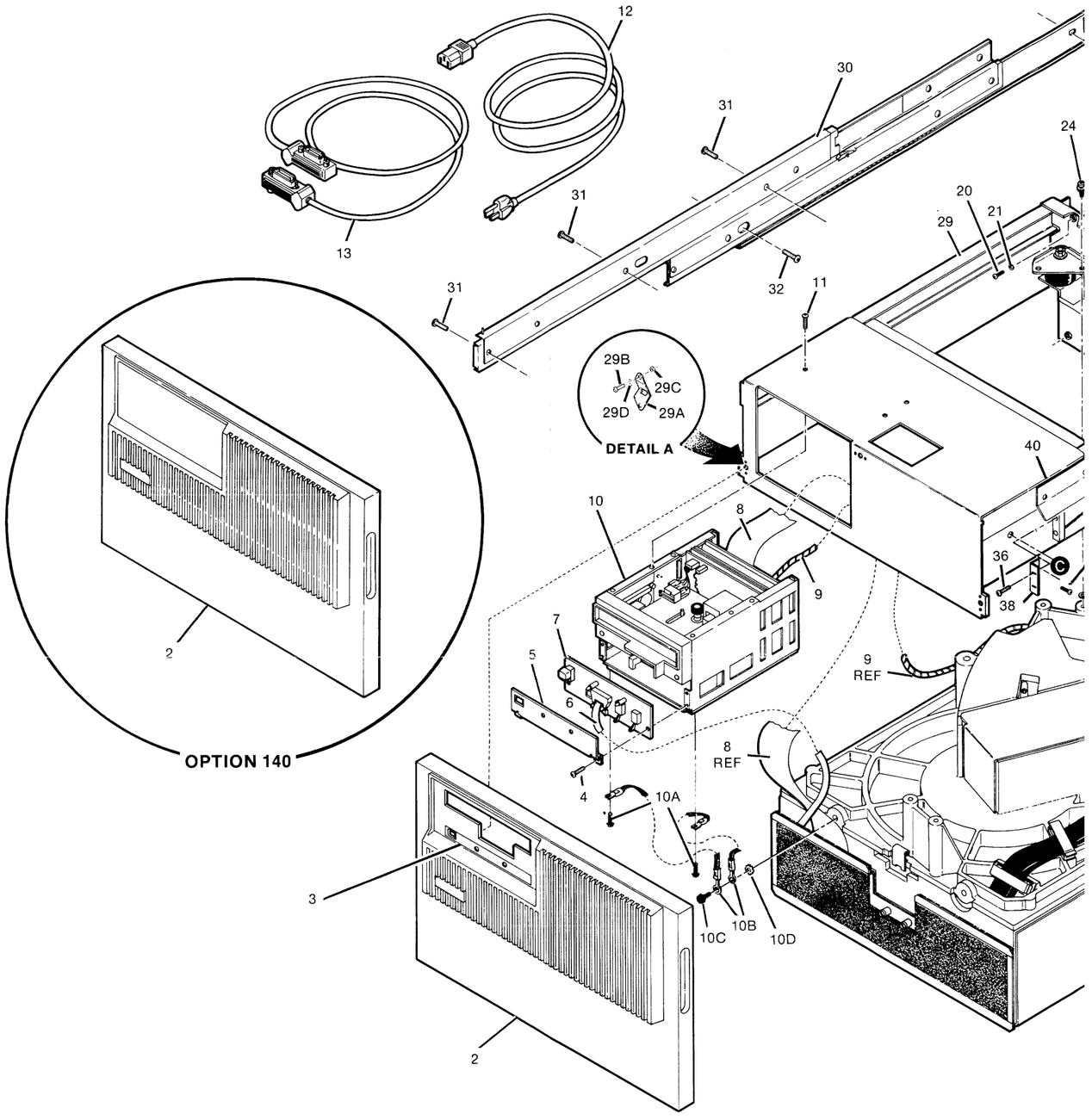
Figure 6-1. Stand-Alone Drives, Exploded View

Table 6-2. Rackmount Drives, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-2-	7911R	DISC/TAPE DRIVE, rackmount	28480	7911R	REF
	7912R	DISC/TAPE DRIVE, rackmount	28480	7912R	REF
	7914R	DISC/TAPE DRIVE, rackmount	28480	7914R	REF
1		Deleted			
2	07911-60080	*PANEL, front, 7911R	28480	07911-60080	1
	07911-60081	*PANEL, front, 7911R, Option 140	28480	07911-60081	REF
	07912-60108	*PANEL, front, 7912R	28480	07912-60108	REF
	07912-60109	*PANEL, front, 7912R, Option 140	28480	07912-60109	REF
	07914-60108	*PANEL, front, 7914R	28480	07914-60108	REF
	07914-60109	*PANEL, front, 7914R, Option 140	28480	07914-60109	REF
3	07908-00039	**LABEL, front panel	28480	07908-00039	1
4	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	2
5	07908-00047	*ELECTROSTATIC DISCHARGE SHIELD	28480	07908-00047	1
6	07912-60049	*CABLE, switch (W11)	28480	07912-60049	1
7	07908-60142	*SWITCH, PCA-A15	28480	07908-60142	1
8	07912-60048	*CABLE, tape data (W10)	28480	07912-60048	1
9	07912-60047	*CABLE, tape power (W6)	28480	07912-60047	1
10	07908-60340	*TAPE MODULE (Attaching Parts)	28480	07908-60340	1
10A	No Number	*SCREW, machine, pnh, pozi, 6-32, 5/16 in. long, w/ext-tooth washer	00000	OBD	2
10B	07912-60016	*GROUND STRAP	28480	07912-60016	2
10C	3020-0017	*SCREW, socket cap, 5/16-18 thd., 0.50 in. long	00000	OBD	1
10D	2190-0025	*WASHER, lock, ext tooth, 0.32 in. thick	00000	OBD	1
11	2360-0464	*SCREW, machine, pnh, torque T15, 6-32, 0.375 in. long, w/square cone washer	00000	OBD	2
		— — — x — — —			
12	8120-2371	*POWER CORD, 16 AWG	28480	8120-2371	1
	8120-1351	*POWER CORD, BS 1363/CEE	28480	8120-1351	REF
	8120-1369	*POWER CORD, ASC 112/CEE	28480	8120-1369	REF
	8120-1689	*POWER CORD, GMBH/CEE	28480	8120-1689	REF
	8120-1860	*POWER CORD, CEE/CEE	28480	8120-1860	REF
	8120-2104	*POWER CORD, SEV/CEE	28480	8120-2104	REF
	8120-2956	*POWER CORD, MDPP/CEE	28480	8120-2956	REF
13	8120-3446	*CABLE, HP-IB, 2 metre (Model 10833B)	28480	8120-3446	1
14	07912-60074	*GROUND STRAP (Attaching Parts)	28480	07912-60074	1
15	0515-0441	*SCREW, machine, pnh, torque T30, M6.0 by 1.0, 12 mm long, w/square cone washer	00000	OBD	2
16	2190-0070	*WASHER, lock, ext-tooth, 0.256 in. ID	00000	OBD	2
		— — — x — — —			
17	07912-60046	*CABLE, HP-IB, DMA (W1)	28480	07912-60046	1
18	07912-60046	*CABLE, tape, HP-IB, DMA (W2 Option 001)	28480	07912-60046	1
19	07912-60028	*POWER SUPPLY ASSEMBLY (see figure 6-4) (Attaching Parts)	28480	07912-60028	1
20	0515-0386	*SCREW, machine, pnh, torque T25, M5.0 by 0.8, 10 mm long, w/square cone washer	00000	OBD	1
21	2190-0587	*WASHER, lock, helical, 5.1 mm ID	00000	OBD	1
22	07912-00067	*CLAMP, power supply assembly	28480	7912-00067	1
23	0515-0638	*SCREW, machine, pnh, torque T25, M5.0 by 0.8, 14 mm long, w/square cone washer	00000	OBD	1
		— — — x — — —			
24	0515-0442	*SCREW, machine, pnh, torque T30, M6.0 by 1.0, 16 mm long, w/square cone washer	00000	OBD	6
24A	3050-0583	*WASHER, flat, 0.281 in. ID, 0.625 in. OD, 0.05 in. thick	00000	OBD	6
25	No Number	*DISC MODULE (see figure 6-3)	28480	NSR	1
26	2950-0169	*NUT, hex, 0.50 in.	00000	OBD	6
27	07912-00050	*BRACKET, shock mount	28480	07912-00050	3
28	1520-0210	*SHOCK MOUNT, rubber, 1.0 in. long, threaded shank	81860	A 43-051	3
28A	07912-60017	*GROUND STRAP	28480	07912-60017	3
29	07912-00048	*CHASSIS, rackmount	28480	07912-00048	1

Table 6-2. Rackmount Drives, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-2-					
29A	1390-0681	**STUD RETAINER (Attaching Parts)	28480	1390-0681	3
29B	2200-0166	**SCREW, machine, pnh, pozi, no. 4, 0.312 in. long	00000	OBD	2
29C	2260-0001	**NUT, hex, 4-40	00000	OBD	2
29D	2190-0411	**WASHER, lock, ext-tooth, no. 4 — — — x — — —	00000	OBD	2
30	5180-0521	*RACK SLIDE; PAIR (Attaching Parts)	28480	5180-0521	1
31	0515-0381	*SCREW, machine, pnh, torque T20, M4.0 by 0.7, 10 mm long	00000	OBD	6
32	2680-0283	*SCREW, machine, pnh, slotted, 10-32, 0.5 in. long — — — x — — —	00000	OBD	4
33		DELETED			
34		DELETED			
35		DELETED			
36	2680-0278	*SCREW, machine, pnh, torque T25, 10-32, 0.5 in. long, w/square cone washer	00000	OBD	4
37	07912-00075	*SPACER, rack-mounting (NOTE: Used only on early production units.)	28480	07912-00075	2
38	07912-00077	*RACK EAR (Attaching Parts)	28480	07912-00077	2
39	0515-0386	*SCREW, machine, pnh, torque T25, M5.0 by 0.8, 10 mm long, w/square cone washer — — — x — — —	00000	OBD	2
40	07914-00001	*BRACKET, installation (Attaching Parts)	28480	07914-00001	2
41	0515-0386	*SCREW, machine, pnh, torque T25, M5.0 by 0.80, 10 mm long — — — x — — —	00000	OBD	2



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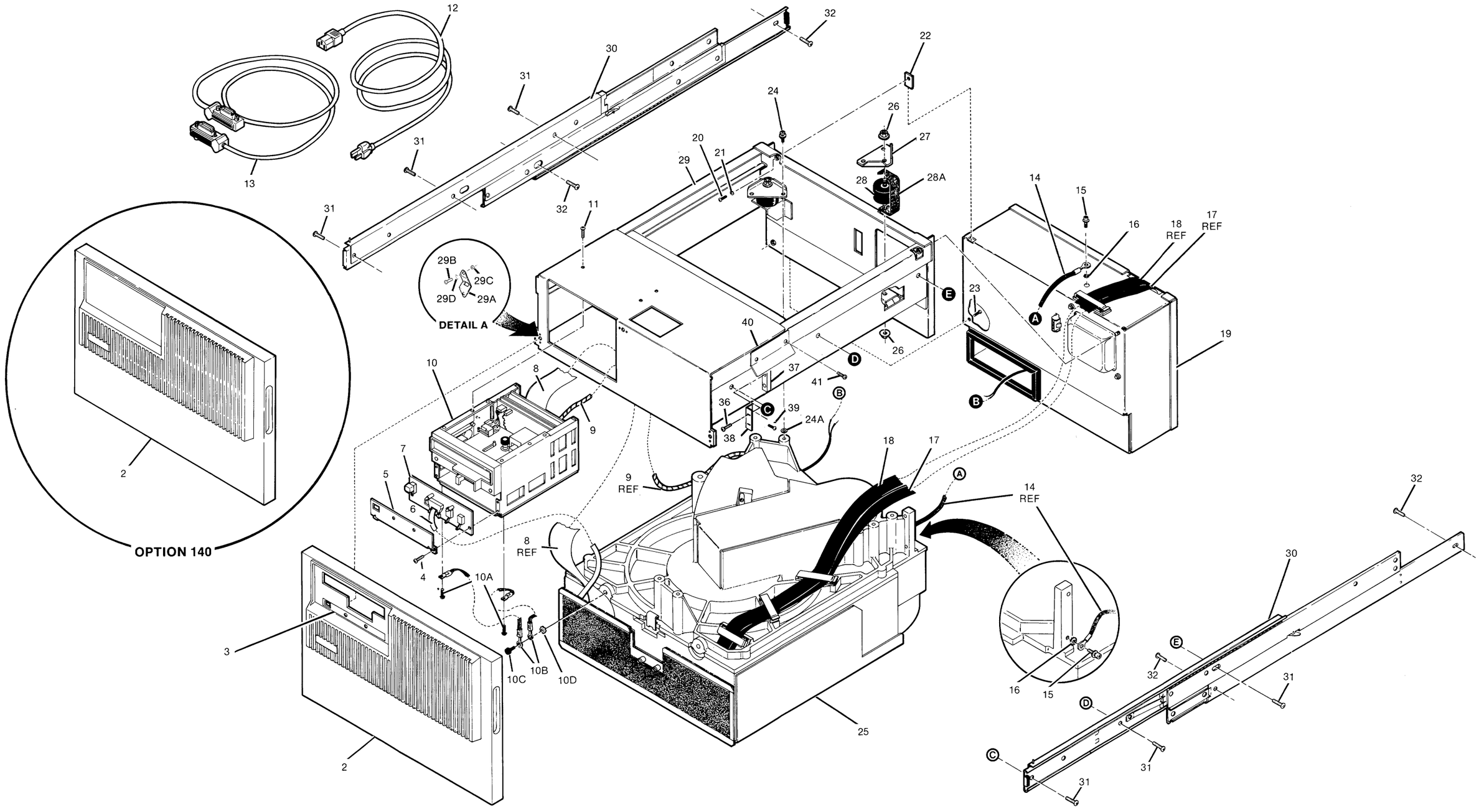


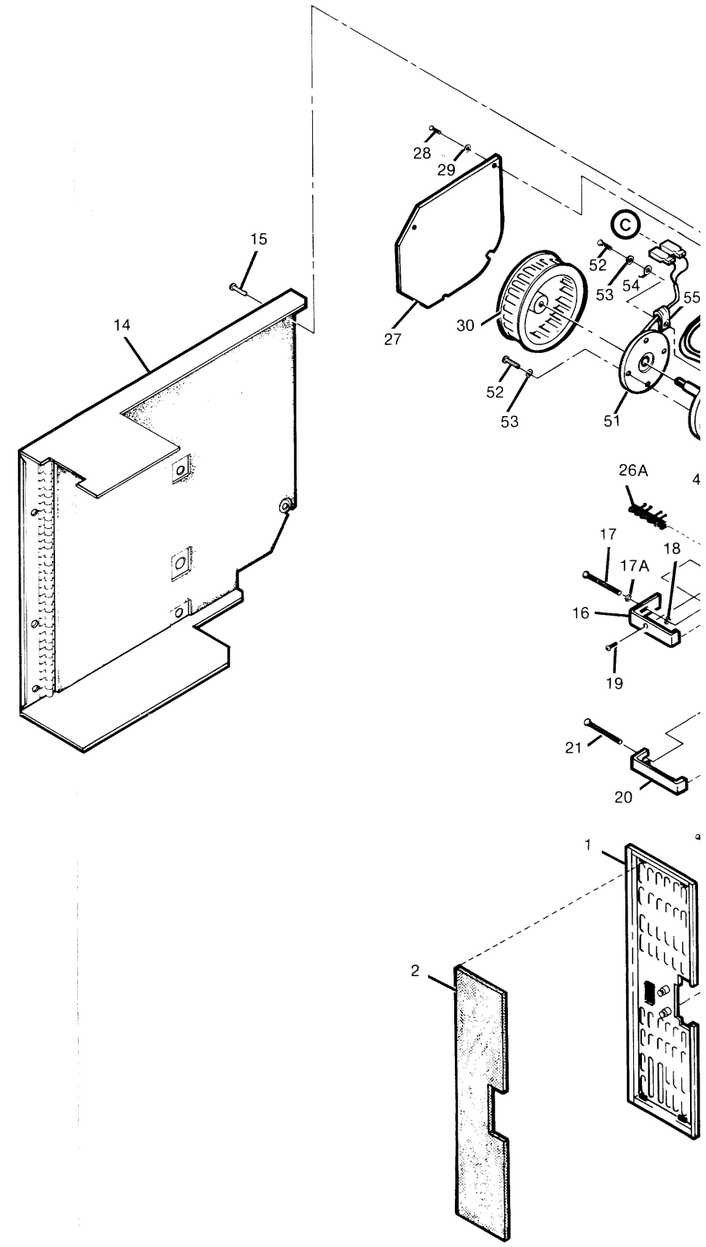
Figure 6-2. Rackmount Drives, Exploded View

Table 6-3. Disc Module, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-	No Number	DISC MODULE (48, figure 6-1; 25, figure 6-2)	28480	NSR	REF
1	07912-60072	*SHIELD ASSEMBLY, card cage	28480	07912-60072	1
2	07912-40027	*AIR FILTER, foam	28480	07912-40027	1
3	07912-60010	*DMA PCA-A1 (Option 001)	28480	07912-60010	1
4	07912-60011	*MICROPROCESSOR PCA-A2 (Option 001)	28480	07912-60011	1
5	07912-60011	*MICROPROCESSOR PCA-A3	28480	07912-60011	1
5A	07914-10103	*EPROM KIT FOR MPU BOARD (not shown)	28480	07914-10103	1
5B	07914-89142	**EPROM, U261 (used for upgrading REV 5.0 firmware to REV 5.1)	28480	07914-89142	1
6	07912-60010	*DMA PCA-A4	28480	07912-60010	1
7	07908-60241	*TIB PCA-A6	28480	07908-60241	1
8	07912-60008	*JUMPER PCA-A7 (Standard units)	28480	07912-60008	1
9	07914-60004	*READ/WRITE PCA-A8 (7911 and 7912)	28480	07914-60004	1
	07914-60104	*READ/WRITE PCA-A8 (7914)	28480	07914-60104	REF
10	07914-60001	*SERVO PCA-A9	28480	07914-60001	1
11	07912-60200	*DISC MECHANISM (60 Hz)	28480	07912-60200	1
	07911-60200	*DISC MECHANISM (60 Hz)	28480	07911-60200	REF
	07914-60100	*DISC MECHANISM (60 Hz)	28480	07914-60100	REF
	07911-60250	*DISC MECHANISM (50 Hz)	28480	07911-60250	REF
	07912-60250	*DISC MECHANISM (50 Hz)	28480	07912-60250	REF
	07914-60250	*DISC MECHANISM (50 Hz)	28480	07914-60250	REF
12	07912-00076	**BRACKET, card cage shield assembly (Attaching Parts)	28480	07912-00076	1
13	0624-0530	**SCREW, tapping, pnh, torque T20, 0.375 in. long — — — x — — —	00000	OBD	3
14	07912-60099	**COVER, disc mechanism (Attaching Parts)	28480	07912-60099	1
15	0624-0530	**SCREW, tapping, pnh, torque T20, 0.375 in. long — — — x — — —	00000	OBD	9
16	07912-00023	**BRACKET, motherboard, large (Attaching Parts)	28480	07912-00023	1
17	0624-0531	**SCREW, tapping, pnh, torque T20, 0.750 in. long	00000	OBD	1
17A	2190-0411	**WASHER, lock, ext-tooth, no. 4	00000	OB	1
18	2190-0467	**WASHER, lock, ext-tooth, 0.195 in. ID	00000	OBD	1
19	0515-0104	**SCREW, machine, pnh, pozi, M3.0 by 0.50, 8 mm long — — — x — — —	00000	OBD	1
20	07912-00022	**BRACKET, motherboard, small (Attaching Parts)	28480	07912-00022	1
21	0624-0531	**SCREW, tapping, pnh, torque T20, 0.750 in. long — — — x — — —	00000	OBD	1
22	07912-60044	**HARNESS, power (W7)	28480	07912-60044	1
23	07912-60045	**CABLE, power sense (W8)	28480	07912-60045	1
24	07912-60071	**CABLE, motor relay (W13)	28480	07912-60071	1
25	07912-60097	**CABLE, motor brake extender (W5)	28480	07912-60097	1
26	07912-60103	**MOTHERBOARD PCA-A11	28480	07912-60103	1
	07914-60103	**MOTHERBOARD PCA-A11 (7914 only)	28480	07914-60103	REF
26A	07912-40035	**MOTHERBOARD INSERT	28480	07912-40035	4
27	07912-00020	**COVER, blower wheel (Attaching Parts)	28480	07912-00020	1
28	0624-0529	**SCREW, machine, pnh, torque T7, 0.375 in. long	00000	OBD	3
29	3050-0890	**WASHER, flat, 2.78 mm ID, 0.5 mm thick — — — x — — —	00000	OBD	3
30	3160-0292	**BLOWER WHEEL, 94 ft³/min.	95933	B481-1755	1
31	07912-60026	**COVER, drive belt (Attaching Parts)	28480	07912-60026	1
32	0515-0383	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer — — — x — — —	00000	OBD	4

Table 6-3. Disc Module, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-3-					
33	07912-00011	**SHIPPING LOCK, spindle (Attaching Parts)	28480	07912-00011	1
34	0515-0383	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer	00000	OBD	2
35	0380-0105	**SPACER, round, 0.25 in. long — — — x — — —	00000	OBD	1
36	07912-40017	**DRIVE BELT, 60 Hz	28480	07912-40017	1
	07912-40018	**DRIVE BELT, 50 Hz (Option 015)	28480	07912-40018	REF
37	07912-60064	**SPRING TENSION ASSEMBLY (Attaching Parts)	28480	07912-60064	1
38	0515-0383	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer — — — x — — —	00000	OBD	2
39	0515-0383	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer	00000	OBD	1
40	2190-0413	**WASHER, lock, ext-tooth, 0.168 in. ID	00000	OBD	1
41	0515-0383	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer	00000	OBD	1
42	0590-1395	**NUT, hex, plastic, locking, 0.5 in. (supplied with item 45)	75237	2 INTE-518	1
43	07912-20024	**PULLEY, motor, 60 Hz	28480	07912-20024	1
	07912-20013	**PULLEY, motor, 50 Hz (Option 015)	28480	07912-20013	REF
44	1500-0625	**WOODRUFF KEY (supplied with item 45)	28480	1500-0625	1
45	07912-60063	**MOTOR ASSEMBLY (Attaching Parts)	28480	07912-60063	1
46	0515-0638	**SCREW, machine, pnh, torque T25, M5.0 by 0.8, 14 mm long	00000	OBD	3
47	2190-0587	**WASHER, lock, helical, 5.1 mm ID	00000	OBD	4
48	0535-0022	**NUT, hex, M5.0 by 0.8	00000	OBD	1
49	2190-0402	**WASHER, flat, 5.4 mm ID	00000	OBD	4
50	07912-20039	**SPACER, tension stud — — — x — — —	28480	07912-20039	1
51	07912-20036	***BRAKE, motor (Attaching Parts)	28480	07912-20036	1
52	0515-0638	***SCREW, machine, pnh, torque T25, M5.0 by 0.8, 14 mm long	00000	OBD	4
53	2190-0587	***WASHER, lock, helical, 5.1 mm ID	00000	OBD	4
54	3050-0894	***WASHER, flat, 5.40 mm ID, 1.0 mm thick	00000	OBD	1
55	1400-0291	***CLAMP, cable — — — x — — —	00000	OBD	1
56	07912-60111	**SPEED SENSOR ASSEMBLY (Attaching Parts)	28480	07912-60111	1
57	0515-0383	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer — — — x — — —	00000	OBD	2
58	07912-60039	**GROUND SCREW ASSEMBLY	28480	07912-60039	1



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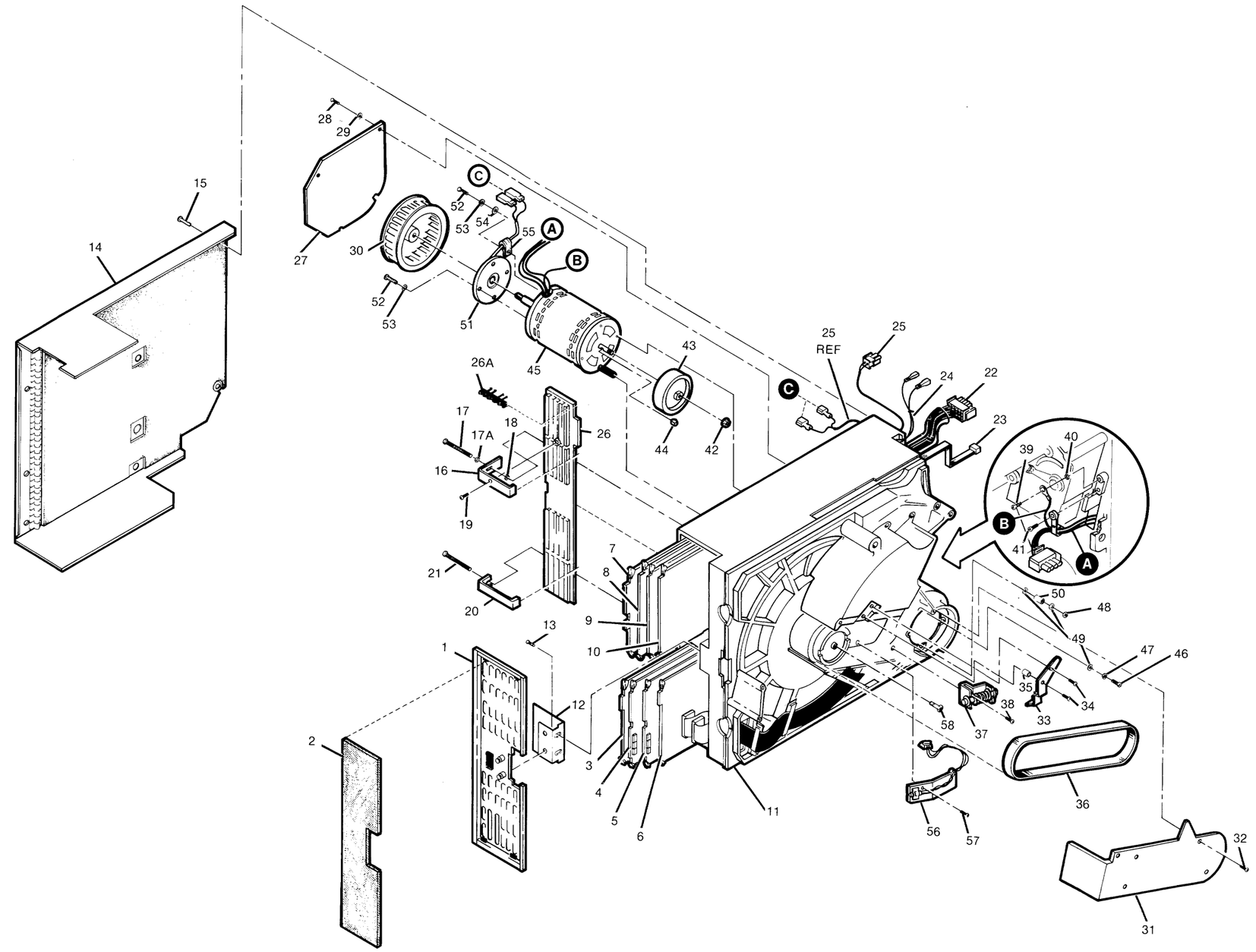

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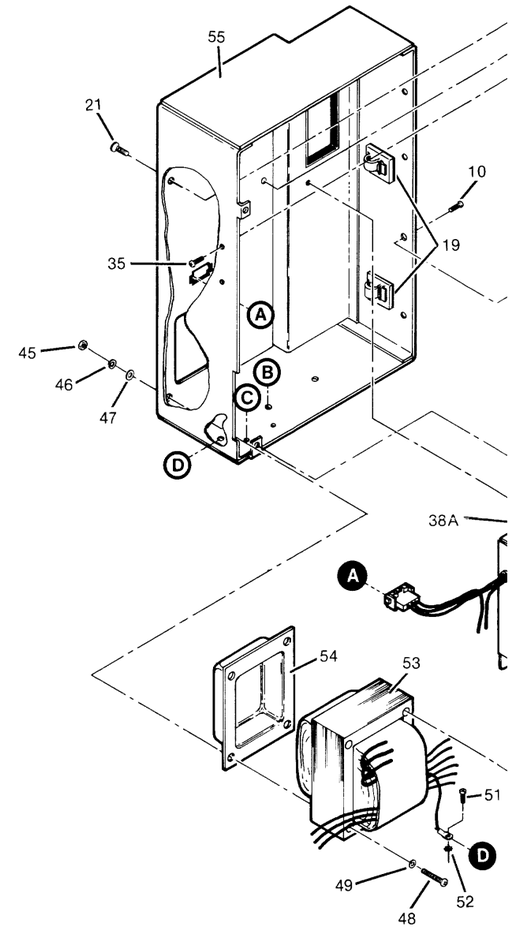
Figure 6-3. Disc Module Assembly, Exploded View

Table 6-4. Power Supply Assembly, Replaceable Parts

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-4-	07912-60028	POWER SUPPLY ASSEMBLY (40, figure 6-1; 19, figure 6-2)	28480	07912-60028	REF
1	07912-60006	*POWER REGULATOR PCA-A13	28480	07912-60006	1
		(Attaching Parts)			
2	0515-0383	*SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer	00000	OBD	7
		— — — x — — —			
3	2110-0342	**FUSE, 8A, 250V, (F640)	03614	ABC-8	1
4	2110-0250	**FUSE, 25A, 32V, (F630)	75915	311025	1
5	2110-0003	**FUSE, 3A, 250V, (F660)	75915	312003	1
6	07912-60009	*HP-IB PCA-A14	28480	07912-60009	1
		(Attaching Parts)			
7	0380-0643	*STANDOFF, hex, 6-32, 0.255 in. long	00000	OBD	4
		— — — x — — —			
	07912-60058	*POWER SUPPLY SUBASSEMBLY	28480	07912-60058	1
8	07912-00028	**DOOR, power supply	28480	07912-00028	1
		(Attaching Parts)			
9	0515-0390	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer	00000	OBD	2
10	0515-0390	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer	00000	OBD	4
		— — — x — — —			
11	07912-60095	**POWER SWITCH AND FUSE ASSEMBLY	28480	07912-60095	1
		(Attaching Parts)			
12	0515-0390	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer	00000	OBD	2
		— — — x — — —			
13	2110-0565	**CAP, fuseholder	00000	OBD	1
14	2110-0051	***FUSE, 10A, 250V, (F1)	03614	ABC-10	1
	2110-0030	***FUSE, 5A, 250V (Option 015)	75915	313005	REF
15	07912-60083	***WIRE ASSEMBLIES, primary power	28480	07912-60083	1
16	5061-3132	**LINE FILTER ASSEMBLY (FL1)	28480	5061-3132	1
		(Attaching Parts)			
17	0515-0390	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer	00000	OBD	2
18	2190-0413	**WASHER, lock, ext-tooth, 0.168 in. ID	00000	OBD	2
		— — — x — — —			
19	1400-0972	**CLIP, cable, nylon, self-locking, adhesive mtg	34785	021-0500	3
20	2110-0054	**FUSE, 15A, 250V, (F2, F3)	75915	314015	2
	07912-60076	**POWER CAPACITOR ASSEMBLY	28480	07912-60076	1
		(Attaching Parts)			
21	0515-0438	**SCREW, machine, pnh, torque T25, M5.0 by 0.8, 6 mm long, w/square cone washer	00000	OBD	3
		— — — x — — —			
22	1906-0205	***BRIDGE RECTIFIER, fw 200V, 30A (CR3)	27777	VK248	1
		(Attaching Parts)			
23	0515-0382	***SCREW, machine, pnh, torque T15, M4.0 by 0.7, 12 mm long, w/square cone washer	00000	OBD	1
		— — — x — — —			
24	07912-60096	***COVER, power capacitor assembly	28480	07912-60096	1
		(Attaching Parts)			
25	0515-0380	***SCREW, machine, pnh, torque T15, M4.0 by 0.7, 10 mm long, w/square cone washer	00000	OBD	2
		— — — x — — —			
26	2680-0278	***SCREW, machine, pnh, torque T25, 10-32, 0.5 in. long, w/square cone washer	00000	OBD	6
27	2190-0011	***WASHER, lock, int-tooth, 0.195 in. ID	00000	OBD	18
28	07912-60068	***BLEEDER RESISTOR ASSEMBLY (R1, R2, R3)	28480	07912-60068	3
29	0180-3140	***CAPACITOR, fxd, 0.15F, 20 Vdc (C1)	00853	101X154U020DF2A	1
30	0180-3138	***CAPACITOR, fxd, 0.06F, +75%, -10%, 40 Vdc (C2)	56699	3186GE603U050BH	1
31	0180-3139	***CAPACITOR, fxd, 0.04F, +75%, -10%, 40 Vdc (C3)	56699	3186FE403U050BH	1

Table 6-4. Power Supply Assembly, Replaceable Parts (continued)

FIG. & INDEX NO.	HP PART NO.	DESCRIPTION	MFR CODE	MFR PART NO.	UNITS PER ASSY
6-4-					
32	07912-00039	***CHASSIS, power capacitor assembly	28480	07912-00039	1
33	07912-60081	**WIRE ASSEMBLIES, unregulated power	28480	07912-60081	1
34	07912-60061	**DIODE ASSEMBLY (CR1, CR2) (Attaching Parts)	28480	07912-60061	1
35	0515-0390	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer — — — x — — —	00000	OBD	1
36	07912-60054	**HARNESS, unregulated power	28480	07912-60054	1
37	07912-60075	**MOTOR CONTROL ASSEMBLY (Attaching Parts)	28480	07912-60075	4
38	0515-0390	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer — — — x — — —	00000	OBD	3
38A	0490-1321	***RELAY, solid-state	28480	0490-1321	1
39	07912-40026	**SHIELD, primary (Attaching Parts)	28480	07912-40026	1
40	0515-0437	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 35 mm long, w/square cone washer — — — x — — —	00000	OBD	2
41	0515-0383	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 16 mm long, w/square cone washer	00000	OBD	2
42	2360-0462	**SCREW, machine, pnh, torque T10, 6-32, 0.250 in. long, w/square cone washer	00000	OBD	11
42A	07912-60110	**POWER LINE SNUBBER	28480	07912-60110	1
43	0360-1918	**TERMINAL BLOCK, phenolic, 7 terminal, twin screw (TB1)	71785	354-64-07-001	2
44	0360-0625	**MARKER STRIP, 7 terminal	75382	MS671-7-1A	1
		Note: Items 45 through 47 are used on models 7911P and 7912P only.			
45	0535-0021	**NUT, hex, M6.0 x 1.0, 10 mm	00000	OBD	2
46	2190-0592	**WASHER, lock, helical, 6.25 mm ID	00000	OBD	2
47	3050-0583	**WASHER, flat, 0.281 in. ID	00000	OBD	2
48	0515-0453	**SCREW, machine, pnh, torque T30, M6.0 by 1.0, 65 mm long	00000	OBD	4
49	3050-0583	**WASHER, flat, 0.281 in. ID	00000	OBD	4
50	07912-00038	**PLATE, barrier block	28480	07912-00038	1
51	0515-0390	**SCREW, machine, pnh, torque T15, M4.0 by 0.7, 6 mm long, w/square cone washer	00000	OBD	1
52	2190-0413	**WASHER, lock, ext-tooth, 0.168 in. ID	00000	OBD	1
53	9100-4222	**TRANSFORMER, power (T1)	28480	9100-4222	1
54	7100-0238	**COVER, transformer, 1.25 in. deep	28480	7100-0238	1
55	07912-00027	**CHASSIS, power supply	28480	07912-00027	1



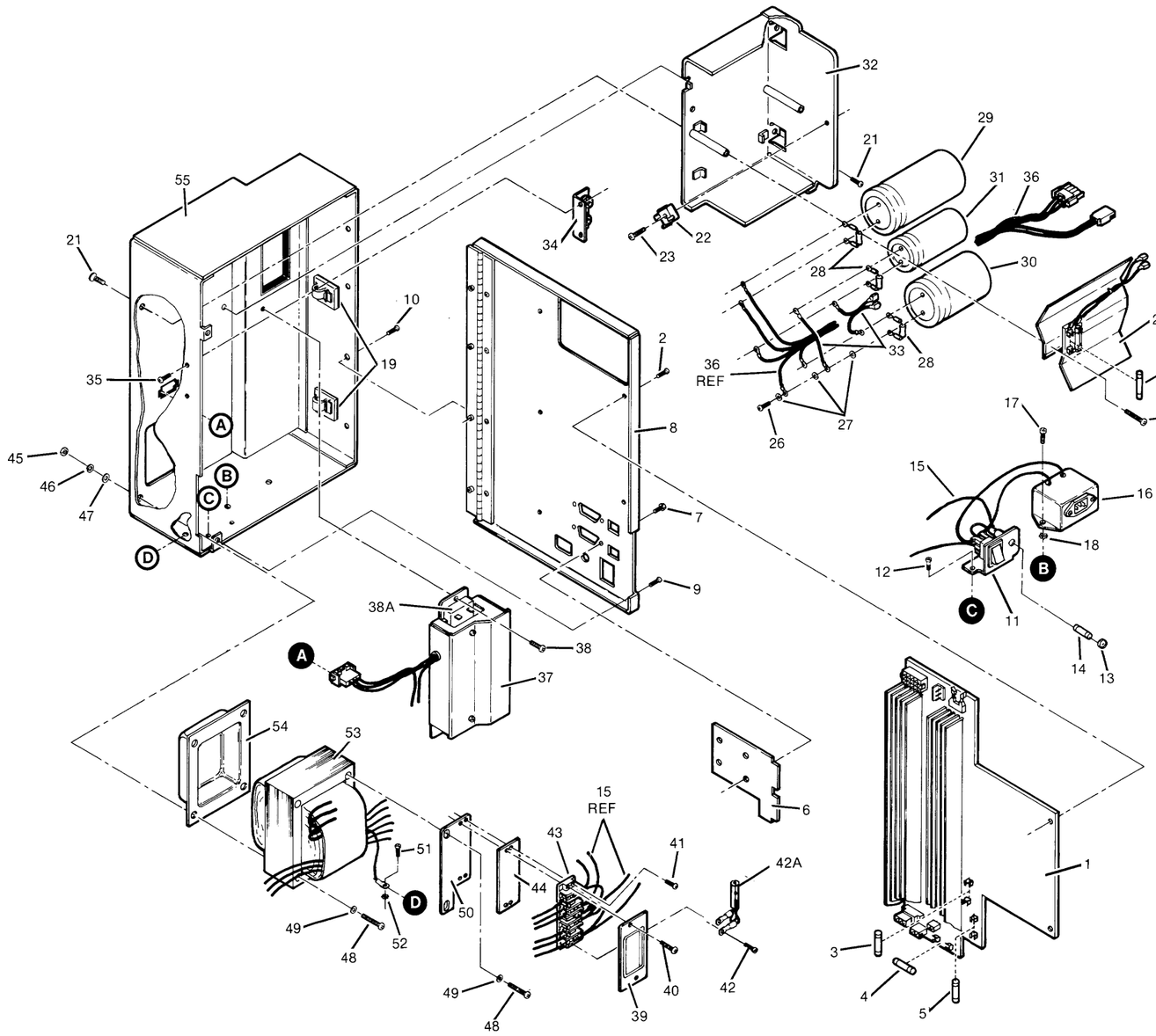


Figure 6-4. Power Supply Assembly, Exploded View

Table 6-5. Reference Designations and Abbreviations

REFERENCE DESIGNATIONS

A	= assembly	J	= jack, receptacle connector	T	= transformer
B	= blower, fan, motor, synchro	K	= relay	TB	= terminal board
C	= capacitor	L	= inductor	TP	= test point
CB	= circuit breaker	M	= meter	U	= integrated circuit, non-repairable assembly
CR	= diode	MP	= mechanical part	VR	= voltage retulator
DS	= indicator lamp	P	= plug connector	W	= cable assembly (with connectors), wire
E	= contact, miscellaneous electrical part	Q	= semiconductor device other than diode or integrated circuit	X	= socket
F	= fuse	R	= resistor	Y	= crystal unit
FL	= filter	RT	= thermistor	Z	= network, tuned circuit
H	= hardware	S	= switch		

ABBREVIATIONS

A	= ampere(s)	ID	= inside diameter	qty	= quantity
ac	= alternating current	in.	= inch, inches		
AR	= as required	incand	= incandescent	rdh	= round head
assy	= assembly	incl	= include(s)	rect	= rectifier
		intl	= internal	ref	= reference
brkt	= bracket	I/O	= input/output	rf	= radio frequency
		k	= kilo (10^3), kilohm	rfi	= radio frequency interference
c	= centi(10^{-2})	kg	= kilogram	rh	= right hand
C	= Celsius, centigrade			rpm	= revolutions per minute
cer	= ceramic	lb	= pound	rwv	= reverse working voltage
cm	= centimetre	LED	= light-emitting diode		
comp	= composition	lh	= left hand	sb	= slow blow
conn	= connector	M	= mega (10^6), megohm	SCR	= semiconductor-controlled rectifier
d	= deci(10^{-1})	m	= milli (10^{-3})	scw	= square cone washer
dc	= direct current	mach	= machine	Se	= selenium
deg	= degree(s)	mb	= medium blow	Si	= silicon
dia	= diameter	met oxd	= metal oxide	slftpg	= self-tapping
dpdt	= double-pole, double-throw	mfr	= manufacturer	spdt	= single-pole, double throw
dpst	= double-pole, single-throw	misc	= miscellaneous	spst	= single-pole, single throw
		mm	= millimetre	sst	= stainless steel
elctlt	= electrolytic	mtg	= mounting	stl	= steel
encap	= encapsulated	My	= Mylar	sw	= switch
ext	= external				
		n	= nano (10^{-9})	T	= TORX® screw
F	= Fahrenheit, farad	n.c.	= normally closed	Ta	= tantalum
fb	= fast blow	no.	= number	tgl	= toggle
fh	= flat head	n.o.	= normally open	thd	= thread
fig.	= figure	NSR	= not separately replaceable	Ti	= titanium
filh	= fillister head	ntd	= no time delay	tol	= tolerance
flm	= film				
fw	= full wave	OBD	= order by description	U (μ)	= micro (10^{-6})
fxd	= fixed	OD	= outside diameter		
		ovh	= oval head	V	= volt(s)
G	= giga(10^9)	oxd	= oxide	var	= variable
Ge	= germanium			Vdcw	= direct current working volts
		p	= pico (10^{-12})		
H	= henry, henries	PCA	= printed-circuit assembly	W	= watt(s)
hd	= head	phh	= phillips head	w/	= with
hex	= hexagon, hexagonal	pnh	= pan head	WIV	= inverse working volts
hlcl	= helical	P/O	= part of	ww	= wire-wound
Hz	= Hertz	pot	= potentiometer		
		pozi	= Pozidriv		

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Table 6-6. Code List of Manufacturers

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbooks H4-1, and H4-2, and their supplements.

CODE NO.	MANUFACTURER	ADDRESS
00853	Sangamo Weston Inc. Sangamo Capacitor Div.	Pickens, SC
03614	McGraw Edison Co. Bussman Manufacturing Div.	St. Louis, MO
14480	Lobaugh Rollin J	So. San Francisco, CA
23880	Stanford Applied Engineering Inc.	Santa Clara, CA
27777	Varo Inc. Electron Devices Div.	Garland, TX
28480	Hewlett-Packard Co.	Palo Alto, CA
34785	DEK Inc.	W. Chicago, IL
56501	The Thomas and Betts Corp.	Raritan, NJ
56699	Mepco/Electra Inc.	Columbia, SC
71785	TRW Inc. TRW Cinch Connectors	Elk Grove Village, IL
75237	Microdot Manufacturing Inc. Kaymar Manufacturing Div.	Fullerton, CA
75382	Kulka Electric Corp.	Mount Vernon, NY
75915	Littelfuse Inc.	Des Plaines, IL
81860	Barry Wright Corp. Barry Division	Watertown, MA
95933	Revcor Inc.	Carpentersville, IL

APPENDIX A
SERVICE NOTES

CONTENTS

CONTENTS (continued)

7908-01 A
7911-01 A
7912-01 A

SERVICE NOTE

Supersedes: 7908-01, 7911-01
7912-01

APPLIES TO:	All Units X	Only Units on Agreement ☐
PERFORM:	Immediately ☐ On Failure	At PM/Normal Call ☐ Information Only X

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:		X	
PARTS:		X	
TRAVEL:		X	

SERVICE INVENTORY	Return for update ☐ Return for salvage ☐	Use as is ☐ See text X
WARRANTY EXTENDED UNTIL:		

MODELS AFFECTED: 88140S, 88140L

DATE CODES INVOLVED: 2XX41-XXXX
through 2XX49-XXXX
(88140S)

5XX41-XXXX
through 5XX48-XXXX
(88140L)

7908/11/12 DISC BACKUP TAPE CARTRIDGES

SYMPTOMS: The most noticable symptoms are:

1. Tape fails initialization with a "unit fault" or an "uninitialized media status."
2. Initialization takes much longer than normal.*
3. There are a high number of spares used during initialization.*
4. Heads have vertical brown streak (oxide debris) in the white portion of the head.

CAUSE: Some tapes produced in November and December of 1981 are dirty and have a tendency to clog heads faster than normal. In most cases, the tapes are usable, but do require head cleaning more often for the first two or three times they are used. Remember writing tapes with a dirty head will cause data to be written with a high data error rate.

ACTION: The tape should be usable if the following is done:

1. CLEAN the heads!
2. Re-Certify the tape.
3. Read the ERT LOG and the Spare Table.
4. If the number of errors or spares is less than the table below shows, then the tape will be usable under standard usage.

* Table of values for misc tape drive characteristics on following page:

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(continued on reverse)

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	88140S	88140L
Number of Permanent error on one pass of certify or error rate test. (worst case)	64	256
Number of Transient errors after one pass of certify or error rate test. (worst case)	128	512
Number of spares used. (worst case)	5	20
Number of spares available.	32	128
Time to initialize	18 min	64 min

7911 P/R-02

SERVICE NOTE

Supersedes:

7911P/R Disc/Tape Drive

All Units With Serial Number Prefix 2205A and Below

Mandatory MPU Firmware Update

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☒
	On Failure ☐	Information Only ☐

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	.3 hr		
PARTS:	X		
TRAVEL:			X

SERVICE INVENTORY	Return for update ☒	Use as is ☐
	Return for salvage ☐	See text ☐

WARRANTY EXTENDED UNTIL: 15 April '83

SYMPTOM: Mandatory next site visit update of MPU firmware in all 7911P/R disc drives with a serial number prefix of 2205A and below.

CAUSE: The latest revision MPU firmware contains fixes for many low level bugs. In addition to these fixes, the new TIB PCA (07908-6X241) requires updated firmware (see service note 7911P/R-03). A mandatory update is being implemented because of the wide number of symptoms. No single symptom, however, requires a mandatory update.

SOLUTION: On the next visit to the customer's site the CE should update the MPU firmware by installing a 07912-19004 exchange EPROM kit. The revision level of MPU firmware can be checked by noting the individual EPROM's part numbers. The 07912-19004 EPROM KIT firmware will have the following numbers:

U241 - 07912-89020
U261 - 07912-89021
U271 - 07908-89059
U291 - 07908-89060
U2101 - 07908-89061
U121 - 07908-89062

Note: These EPROM's are not individually replaceable. The EPROM kit (which includes all six EPROMS) must always be ordered.

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(cont.)

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The MPU EPROM kit is now supplied through the Corporate Parts Center's (CPC, or div 15) Blue Stripe Exchange program. The Exchange EPROM kit part number is 07912-19004. Defective exchange kits should be returned to CPC/PCE (Div. 15) and NOT to CSD (Div. 50). All service kits must be updated with the 07912-19004 revision firmware.

Note: As prevously stated, the 07908-69241 TIB PCA requires 07912-19004 revision MPU firmware. However, the old revision TIB PCA (07908-69141) will work correctly with the new revision firmware. It's not necessary to update the TIB PCA when new firmware is installed.

DMD will accept extended warranty (02G) as follows:

Parts - 07912-19004 Exchange EPROM Kit. (DMD will not accept warranty billings for new EPROM kits 07912-10004. Only the exchange kit will be accepted.)

Labor - .3 hours

Travel - None - update should be done during the CE's next site visit.

****
* NOTE: When completing the Customer Support Order (CSO) form *
* the service code block should be filled in with: "0002" *
* This code will allow DMD to monitor the implementation *
* of this service note and prevent rejection of warranty *
* billing. *
****

7911P/R-03

SERVICE NOTE

Supersedes:

7911P/R Disc/Tape Drive

All Units With Serial Number Prefix 2205A and Below

Cartridge Tape Read or Certify Errors

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	.7		
PARTS:	X		
TRAVEL:	X		
SERVICE	Return for update ☒		Use as is ☐
INVENTORY	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '83		

SYMPTOM: Falsely reported uncorrectable tape data errors may occur during a tape read, initialize, or certify. In some cases an uncorrectable tape data error will be followed by an unlocatable block. Although the error is not unrecoverable, the tape subsystem will report it as such.

CAUSE: Tape media defects (dropouts) are normally corrected by the drive's error correction circuitry (ECC). If the ECC cannot correct the error caused by a dropout the defective block will be spared during the tape certify. However, marginal areas on the tape are not always identified by the certify operation. When a read was attempted in an area with a defect, the block would be seen as uncorrectable. Recovery from the error would not occur until well into the next block, rendering that block unlocatable. If the error was detected during normal operation, the location will be in the RUN LOG.

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The Tape Interface Board (TIB) and the Microprocessor PCA's firmware (MPU EPROM Kit) have been modified to prevent the false detection of uncorrectable data. In most cases these modifications will allow recovery of previously written customer data.

SOLUTION: When an unrecoverable tape read error occurs, the CE must update the following assembly:

Tape Interface Board (TIB)
****07908-69241****

The 07908-69241 replaces the 07908-69141. All 07908-69141 TIB PCA's currently in field service inventory (FSI) must be returned to CSD for update.

Important Note:

The 07908-69241 TIB PCA requires the drive to have 07912-19004 (or above) revision MPU firmware. The MPU firmware update is being implemented on all drives with a serial number prefix of 2205A and below. Refer to service note 7911-02 (Mandatory MPU Firmware Update) for details on identifying updated firmware.

DMD will accept warranty as follows:

Parts - 07908-69241 exchange TIB PCA

Labor - .7 hours

Travel - Yes

This service note should be implemented only on failure.

****
* NOTE: When completing the Customer Support Order (CSO) form *
* the service code block should be filled in with: "0003" *
* This code will allow DMD to monitor the implementation *
* of this service note and prevent rejection of warranty *
* billing. *
****

7911P/R-04

SERVICE NOTE

Supersedes:

7911P/R Disc/Tape Drive

Special TIB PCA Update

Drive Serial Numbers
2206AXXXXX through 2209AXXXXX

Parts Affected: 07908-60241
date code E-2206 only.

APPLIES TO:	All Units X ☐	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure X ☐	Information Only ☐

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	.7 hrs		
PARTS:	X		
TRAVEL:	X		

SERVICE INVENTORY	Return for update X ☐	Use as is ☐
	Return for salvage ☐	See text ☐

WARRANTY EXTENDED UNTIL: 15 April '83

SYMPTOMS: 1. Test errors CO (destructive write fault on fault latch) or DA (cannot read spares table on maintenance tracks) may occur during a tape error rate test or certify.

2. Test error 28 (TIB to DMA write path error) incorrectly reported by self-test.

3. When performing a tape read, the TIB state machine may jump into an infinite loop and cause a time-out to be returned.

CAUSE: The symptoms described above were created on the first implementation of the 7908-60241 TIB PCA (date code E-2206). None of these symptoms occur on the 07908-60141 TIB. Because this design error was discovered soon after the 07908-60241 was introduced to production, only approximately 80 7911P/R disc drives are affected by this service note, all of these drives were shipped from DMD from March 1 to March 21,1982.

LR/sg (cont.) 3/82-48

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SOLUTION: The part number of the TIB PCA will remain 07908-69241. The previously described changes will be indicated by a TIB date code of E-2210. All field service inventory will be updated to date code E-2210.

Should one of the symptoms described above occur and the drive serial number prefix is 2206A through 2208A, the CE should replace the TIB PCA. This service note should be implemented only on failure.

DMD will accept extended warranty (02G) as follows:

Parts: 07908-69241
Labor: .7 hours
Travel: Yes

Important Note:
None of the three symptoms described in this service note apply to the 07908-69141 TIB PCA. Refer to service note 7911P/R-03 for information.

```
**********************************************************************
* NOTE: When completing the Customer Support Order (CSO) form       *
*       the service code block should be filled in with: "0004;      *
*       This code will allow DMD to monitor the implementation       *
*       of this service note and prevent rejection of warranty       *
*       billing.                                                     *
**********************************************************************
```

7911P/R-05

SERVICE NOTE

Supersedes: None

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	.3 hr		
PARTS:	X		
TRAVEL:	no		
SERVICE	Return for update ☒		Use as is ☐
INVENTORY	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	May, 1983		

Models Affected: 7911P/R
and 7912 P/R

Serial prefixes involved:
less than 2220

Part numbers involved:
07912-60004-R/W PCA
07912-6X001-Servo PCA

Write-off-track errors

Symptoms: Changes to the read/write and servo boards will eliminate disc write-off-track errors. The part number of the servo board changes from 07912-6X001 to 07912-6X121. The part number for the read/write board changes from 07912-6X004 to 07912-6X104. The new servo board (07912-6X121) is not compatible with the old read/write board (07912-6X004).

Cause: Write-off-track errors are caused by crosstalk between the servo head and data heads. The changes to the read/write and servo boards alter timing between the two, so crosstalk does not affect the servo system or data transfers.

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Action: This service note should be implemented on failure only of the 07912-6X001, 07912-6X004 or 07912-6X100.

Use the following matrix for repair:

Failing Part	Parts Used For Repair
07912-6X001	07912-6X121 and 07912-6X104
07912-6X004	07912-6X104 and 07912-6X121
07912-6X100 or 07911-6X100	07912-6X100 or 07911-6X100 and 07912-6X121* and 07912-6X104*

Note: If the disc drive has the updated boards (07912-6X104 and 07912-6X121) already in place, it is not necessary to replace these additional boards.

Caution: There is the possibility of causing write-off-track errors if the 07912-6X121 is placed in a drive with the 07912-6X004.

Warranty - extended

Labor - .3 hr.

Parts - Yes

Travel - No

7911P/R-06

SERVICE NOTE

Supersedes: 7911P/R-02

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	0.5hr		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☒		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	August, 1983		

7911 P/R Disc/Tape Drive

All units with serial number prefix below 2230

MPU Mandatory Firmware Update

SYMPTOM: Mandatory next site visit MPU firmware update of all 7911 discs with serial number prefix below 2230.

CAUSE: The predominant reason for this firmware update has been tape certification failures due to a "no data found" error. On many systems this error is not reported, but the system indicates "uninitialized media" when the tape initialization (format/certify) aborts.

This firmware revision also forces the ERT log to be updated at tape certification termination. This occurs whether the termination is normal or not.

This new firmware revision also corrects many low-level bugs that are transparent to the user.

SOLUTION: On the next customer site visit, update the firmware by replacing the 6 EPROMS with the new exchange EPROM kit. The part number of the new exchange kit is 07912-19005. This kit is available from CPC/PCE on the Blue Stripe Program. Old EPROMS should be returned for credit to CPC/PCE (Div. 15).

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HEWLETT PACKARD

Following is a list of part numbers of individual EPROMS and the "U" number corresponding to their location on the MPU board (07912-6X011). Enclosed with each kit is a label to signify the drive has been updated. Place this label next to the serial number tag.

NOTE: These individual parts are NOT available. The entire kit must be ordered from CPC, p/n 07912-19005.

07912-89024	U241
07912-89025	U261
07908-89068	U271
07908-89069	U291
07908-89070	U2101
07908-89071	U121

NOTE: This service note supersedes S/N 7911P/R-02.

NOTE: The 7908 EPROM kit cannot be used in the 7911.

DMD will accept extended warranty (02G) as follows:

Parts - 07912-19005 Eprom Exchange Kit
Labor - .5 hours
Travel - no travel will be accepted

DMD will not accept extended warranty for NEW EPROM kits.

****
*NOTE: When completing the customer support order (CSO) *
* form the service code block should be filled in *
* with: "0006". This code will allow DMD to monitor*
* the implementation of this service note and pre *
* vent rejection of warranty billing. *
****

7911P/R-07

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	1.5 hr		
PARTS:	no		
TRAVEL:	1.3 hr		
SERVICE	Return for update ☒		Use as is ☐
INVENTORY	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	November, 1983		

MODELS AFFECTED: 7911P/R

SERIAL PREFIXES INVOLVED:

7911P/R 2248 AND BELOW

PART NUMBERS INVOLVED:

07908-6X140 TAPE MECHANISM
07908-69340 TAPE MECHANISM

TAPE MECHANISM FAILURES

SYMPTOMS:

1. TAPE CERTIFY/INITIALIZE/FORMAT FAILURES

   THE TAPE INITIALIZATION ROUTINE IS A WRITE THEN READ ERROR RATE TEST, WITH SPARING FOR UNCORRECTABLE AND UNLOCATABLE ERRORS. THIS PROCESS CAN BE TERMINATED IF:
   A. ALL SPARES ARE USED.
   B. THE MAINTENANCE TRACK OVERLOWS WITH PERMANENT ERRORS.

   THESE FAILURES INDICATE THAT THE TAPE DRIVE HEAD IS NOT WRITING OR READING THE DATA CORRECTLY. ONLY OCCASIONALLY WILL THE TAPE CARTRIDGE BE THE CAUSE OF THESE FAILURES.

   IF THE INITIALIZATION PROCESS TERMINATES IN ERROR ALL SYSTEMS WILL REPORT "UNINITIALIZED MEDIA". ADDITIONAL INFORMATION ON THE FAILURE WILL BE DISPLAYED ON SOME SYSTEMS.

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7911P/R-07

2. UNRECOVERABLE DATA ERRORS REPORTED ON TAPE UNIT.

UNRECOVERABLE DATA ERRORS WILL BE REPORTED BY THE SYSTEM DRIVER OR THE SYSTEM UTILITY, FROM THE CS80 STATUS WORDS:

3000(MPE) SYSTEMS - LISTLOG2 WILL HAVE AN UNRECOVERABLE ERROR BIT SET IN THE FOURTH FIELD OF THE DEVICE STATUS WORDS.

1000(RTE) SYSTEMS - AN UNRECOVERABLE DATA ERROR WILL BE REPORTED TO THE TERMINAL, WHEN IT OCCURS.

250 SYSTEMS - AN UNRECOVERABLE ERROR BIT WILL BE SET IN THE DISC STATUS RETURNS.

THE TAPE RUN LOG WILL ALSO CONTAIN INFORMATION ABOUT UNRECOVERABLE DATA ERRORS. THE RUN LOG WILL GIVE THE COUNT OF BOTH UNLOCATABLE OR UNCORRECTABLE DATA ERRORS. THESE TWO ERROR TYPES ARE THE SUBSETS OF UNRECOVERABLE ERRORS.

CAUSE: TAPE DRIVES WITH FAULTY READ/WRITE HEADS OR R/W ELECTRONICS, CANNOT RECOVER DATA PROPERLY.

ACTION: IF TAPE INITIALIZATION FAILS OR UNRECOVERABLE ERRORS ARE REPORTED FREQUENTLY, REPLACE THE TAPE DRIVE WITH A TAPE DRIVE WITH A NEW PART NUMBER. A 07908-6X340 WILL HAVE AN IMPROVED READ/WRITE HEAD CONTOUR AND R/W ELECTRONICS. UPON FAILURE REPLACE 07908-6X140 WITH 07908-69340.

****

CAUTION: TAPE INITIALIZATION FAILURES REQUIRE REV. F FIRMWARE BE INSTALLED IN THE DISC. SEE SERVICE NOTE:

7912P/R-06

NOTE: ANY INITIALIZATION FAILURES REQUIRE UPGRADE OF THE TAPE MECHANISM. IF REV.F, p/n07912-19005, HAS NOT BEEN INSTALLED, THIS IS IMMATERIAL. REPLACE THE TAPE MECHANISM AND UPGRADE THE FIRMWARE.

****

7911P/R-07

DMD WILL ACCEPT EXTENDED WARRANTY (02G) AS FOLLOWS:

PARTS - NO
LABOR - 1.5 HOURS
TRAVEL - YES

DMD WILL NOT ACCEPT EXTENDED WARRANTY FOR TAPE MECHANISMS. ANY MECHANISMS REPLACED FOR THE FAILURES DETAILED IN THIS NOTE SHOULD BE RETURNED TO CSD FOR CREDIT. ORDER A REPLACEMENT AS FSI INCREASE, WITH THE COMMENT "!UPDATE". RETURN 07908-6X140 AS A FSI DECREASE. IT WILL BE CROSSREFERENCED TO A 07908-69340.

NOTE: WHEN COMPLETING THE CUSTOMER SUPPORT ORDER (CSO) FORM THE SERVICE CODE BLOCK SHOULD BE FILLED IN WITH: "0007"

THIS CODE WILL ALLOW DMD TO MONITOR THE IMPLEMENTATION OF THIS SERVICE NOTE AND PREVENT REJECTION OF WARRANTY BILLING.

7911P/R-08

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL: April, 1988			

PRODUCTS AFFECTED: 7911 P/R
7912 P/R

7912 SERVO AND MECHANISM COMPATIBILITY

SERIAL DATE CODE AFFECTED - 2301 AND BELOW

SYMPTOM: The 791X-6X200 mechanisms are not compatible with 7912 servo PCA's (07912-6X121 or 07912-6X001).

If a 07912-6X121 or 07912-6X001, servo PCA, is used with a 0791X-6X200 it is possible to experience the following errors (DERRORS are located in the fault log and TERRORS are output on the self-test display.)

1. Uncorrectable data errors.
2. Sector compare error - DERROR 229.
3. Speed not OK error - DERROR 64, bit 5. (Do not confuse this with TERROR 97 - disc unable to spin-up, which indicates a defective speed transducer.)
4. Servo timing pulse register did not change - DERROR 96.

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HEWLETT PACKARD

CAUSE: Differences between the 7912 and the 7914 servo PCA have made the 7914 servo PCA less susceptible to noise on the servo lines than the 7912 servo. The 7914 servo PCA (07914-6X001) is used to test mechanisms, with the following part numbers - 07911-6X200, 07912-6X200, 07914-6X100. Therefore, it is possible for any of these mechanisms to operate normally if a 07914-6X001 servo PCA is used, even though the noise level may be high enough to affect the 07912-6X121.

ACTION: This problem will occur only with the old servo PCA's. The configuration which causes the errors listed above can only occur in the field. Therefore, the only action required is that the 07912-6X001 or 07912-6X121 be replaced with the new servo, 07914-6X001, whenever a new mechanism replaces an old one (0791X-6X100).

COMPATIBLE REPLACEMENT COMBINATIONS:

Servo	Mechanism
07912-6X121	07911-6X100 or 07912-6X100
07914-6X001	0791X-6X100 or 0791X-6X200

INCOMPATIBLE COMBINATION:

Servo	Mechanism
07912-6X121	07911-6X200 or 07912-6X200 or 07914-6X100

NOTE: It is not necessary to update servo PCA's (07912-6X001 or 07912-6X121) in existing drives unless a repair is made which affects compatibility.

Warranty will be extended to cover parts only.

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
* NOTE:  When completing the customer support order (CSO)       *
*        form, the service code block should be filled in       *
*        with "20004". This code will allow DMD to monitor      *
*        implementation of this service note.                   *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7911P/R-09

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:	Update only for existing stock		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	August, 1983		

PRODUCTS AFFECTED:
7911 P/R
7912 P/R

SERIAL PREFIXES AFFECTED:
2251 AND BELOW

SPEED TRANSDUCER ROLLOVER

PROBLEM: Speed transducers have exhibited a higher failure rate than anticipated. This is also a problem with speed transducers in the product support packages. Defective speed transducers will cause self-test failure "9", with an error code "97" (disc unable to spinup). Some discs with early firmware may not complete self-test and/or the motor may turn off after a few minutes of operation.

CAUSE: The speed transducer, positioned beside the spindle, may be defective.

ACTION: If these symptoms are experienced replace the speed transducer. The current part number is 07912-60111. An old transducer (07912-60031) can be used but may exhibit the same symptoms. Ensure that a 07912-60111 has been tried before replacing the disc mechanism.

A properly functioning speed transducer will have a TTL level pulse measured between the green and black wires of the connector to the motherboard.

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HEWLETT PACKARD

ACTION cont.

DO NOT change the disc mechanism for these symptoms until the following actions are taken. First, replace the speed transducer. Check the spindle lock to insure it is disengaged. Also, check the motor assembly. It could be an occasional cause of speed problems, and can be replaced without replacing the disc mechanism. Speed problems may also be the result of a defective servo, read/write or motherboard. Please check these PCA's also. All speed transducers in field stocking inventory with old part numbers (p/n 07912-60031) should be replaced with new ones (p/n 07912-60111).

NOTE: Do not upgrade customer units, except on failure.

****
*
* NOTE: Return current field stock part number *
* 07912-60031 to CPC for credit and order *
* an update, part number 07912-60111. *
*
****

7911P/R-10

S E R V I C E N O T E

Supersedes: None

APPLIES TO:	All Units ☐		Only Units on Agreement ☒
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	X		
PARTS:	07908-69340		
TRAVEL:	X		
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:			

TAPE DESPOOLING

UNITS AFFECTED: 7908 /11/12/14 P/R
With Tape Drives

SERIAL NUMBER
PREFIXES INVOLVED: 2301 To 2310

PARTS AFFECTED: 07908-6X340
Date Code 2237 To 2311

SYMPTOM: Tape is despooled (detached from hub) during autoload. Despooling occurs only if the unit is powered on with the cartridge in place. This symptom may oocur intermittently.

CAUSE: A specification change combined with a design fault in the tape mechansim caused despooling. (Note: an update to the tape mechanism has correted the problem.)

ACTION:
1. On failure, replace tape drives which cause tape despooling with an updated unit. The update has been performed if the date code on the tape drive MPU (on rear of tape drive, rightmost of the three large IC's) is T5PXXXX.
2. If it is not possible to replace the tape drive immediately have the customer insert the tape cartridges only after power on.

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9320-4766 (1/83)

HEWLETT PACKARD

DMD will accept extended warranty (02G) as follows:

Parts - 07908-69340, tape drive.
DMD will not accept warranty for new tape drives 07908-60340.

Labor - 1 hour

Travel - Yes

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                                                                     *
*                              NOTE:                                  *
*                                                                     *
*        When completing the Customer Support Order (CSO)             *
*        form, the service code block must be filled in               *
*        with "20007". Failure to use the service code                *
*        will result in rejection of the warranty billing.            *
*                                                                     *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7911P/R-11B

SERVICE NOTE

Supersedes: 7911/12P/R-11

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	1 hour		
PARTS:	yes		
TRAVEL:	no		
SERVICE INVENTORY	Return for update X ☐		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	July 1984		

Products Affected: 7911P/R
7912P/R

Servo Failures Caused by Backwards Servo Code

Serial Date Prefixes Involved:
2209 and below

Parts Affected:

07912-6X001	Servo PCA (A9)
07912-6X121	Servo PCA (A9)
07911-6X100	7911 Mechanism
07911-6X200	7911 Mechanism
07912-6X200	7912 Mechanism
07912-6X100	7912 Mechanism
07914-6X001	7914 Servo PCA

Symptom: If a 07914-6X001, servo PCA, is placed in a disc drive with reverse servo code the following symptom will occur:

Self test will fail with a "9." and any combination of the following error codes: 90, 96, 97 and Ab.

Do not confuse these symptoms with those exhibited by a drive with a faulty speed transducer. See service note 7912P/R-09.

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9320-4766 (1/83)

HEWLETT PACKARD

Cause: The servo code on some drive mechanisms was written backwards which changes the timing between negative and positive peaks of the servo code. This timing can cause the 7914 servo electronic PCA (07914-6X001) to ignore the servo code di-bits. This happens because the 7914 servo PCA detects a servo di-bit by sensing both the negative and positive peaks of the servo signal. The older servo PCA's, 07912-6X001 and 07912-6X121, are not susceptible to this problem because they utilized only a positive peak detector.

Production safeguards have been implemented on mechanisms with serial date prefixes 2210 and greater to ensure the servo code is written properly.

Action: First check to make sure the errors are not caused by;

a) a faulty speed transducer
b) shipping locks in ship position
c) open fuses on the servo PCA

Then, replace the disc mechanism with a 0791X-69100, date code greater than 2200, or a 0791X-69200.

DMD will pay extended warranty for:

Parts - yes 0791X-69100
or 0791X-69200
Labor - 1 hr.
Travel - no

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                        N O T E :                              *
*                                                               *
*   When completing the Customer Support Order (CSO) form       *
*   the service code block must be filled in with "20008"       *
*   Failure to use the service code will result in rejec-       *
*   tion of the warranty billing.                               *
*                                                               *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7911P/R-12

SERVICE NOTE

Supersedes: None

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☒		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '84		

7911/12 Disc/Tape Drive

Serial Number Prefix Less Than 2326

TITLE: Mandatory Firmware Update to PEP (P/N 07914-19002)

SYMPTOM: All 7911/12 discs produced prior to the 2326 prefix should be updated to PEP. Drives with a serial prefix of 2326 or greater are manufactured with the new firmware and will not require updating.

CAUSE: PEP (performance enhancement) firmware introduces significant improvements in 7911/12 disc reliability and performance. This firmware is backwards compatible and is common to the 7911/12/14. The outstanding result of PEP firmware is a 10-15% increase in drive performance. The additional performance is achieved by changes to the firmware code hierarchy. For often received commands (read and write), the code has been simplified.

There are also many changes in PEP firmware that increase reliability. The reliability enhancements are listed below:

1. "8.dd"
   Diagnostics, initiated by DIAG1 from the External Exerciser, or from MPU switches, will now return an "8.dd" error code only when an uncorrectable error is encountered by the full volume error rate test (ERT). Previous firmware reported an "8.dd" when either an uncorrectable or correctable error was discovered. (The equivalent error logged in the fault log will be TERROR 221. The ERT log will contain the location and type of error of all errors encountered by the ERT, regardless of firmware revision.)

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HEWLETT PACKARD

2. Timeout
   The possibility of microprocessor hangs as a result of erroneous PHI chip interrupts is eliminated. This will decrease the causes of channel time-outs.

3. Tape Restore Errors
   The busy light will flash at the end of a push-button restore if an uncorrectable error has occurred.

4. End of File
   Error conditions are now less likely to affect the recognition of end of file on the tape.

ACTION: At next site visit, replace the existing firmware with PEP, p/n 07914-19002. The following is a list of the part numbers of the individual EPROMS in the kit versus their "U" number assignments on the microprocessor PCA. The individual EPROMS are not orderable.

07914-89031	U241
07914-89032	U261
07914-89033	U271
07914-89034	U291
07914-89035	U2101
07914-89036	U121

The kit, 07914-19002, will be supplied through CPC (Div. 15) Blue Stripe exchange program. All FSI is to be updated to PEP as soon as possible.

NOTE: On dual controllers (option 001) update only the disc MPU (A3).

DMD will accept extended warranty (02G) as follows:

Parts - 07914-19002
Labor - no
Travel - no

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*  NOTE:                                                  *
*  When completing the Customer Support Order (CSO)       *
*  form, the service code block must be filled in         *
*  with "20009". Failure to use the service code          *
*  will result in rejection of the warranty billing.      *
*                                                         *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7911P/R-13

SERVICE NOTE

Supersedes: None

AFFECTED PRODUCTS: 7911P/R
7912P/R
7914P/R

AFFECTED SERIAL PREFIX: 2330

PART NUMBER INVOLVED: 07912-60111

7911/12/14 SPEED SENSOR ASSEMBLIES
(SPEED TRANSDUCERS)

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure ☒	Information Only ☐

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	Yes		
PARTS:	07912-60111		
TRAVEL:	Yes		

SERVICE INVENTORY	Return for update ☐	Use as is ☐
	Return for salvage ☐	See text ☒

WARRANTY EXTENDED UNTIL: May 1, 1984

SYMPTOM: Intermittent speed transducer failures resulting in self test error 9.97 (hex), which decodes as "disc not able to spin up."

CAUSE: Recent speed sensor assemblies with bad crimps at the motherboard connectors.

ACTION: Replace the speed sensor assembly P/N 07912-60111.

DO NOT replace a mechanism for this problem.

If the spin-up error continues see the "Guidelines For 7911/12/14 Mechanism Troubleshooting". (Support Update Supplement, May 13, 1983, #274, CE Handbook Update, October '83. 7911/12/14 Service Manual Update, October '83.)

DMD will accept extended warranty (02G) as follows:

Parts - 07912-60111
Labor - 0.5 hr.
Travel - Yes

* *
* NOTE: When completing the Customer Support Order (CSO) form, the service code block must be filled in with "20013". Failure to use the service code will result in rejection of the warranty billing. *
* *

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9320-4766 (1/83)

HEWLETT PACKARD

7911P/R-14

S E R V I C E N O T E

Supersedes:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	N/A		

Model Numbers: 7908, 7911, 7912, 7914

Parts Involved: Boxes of five tapes;
88140L, 88140LC, 88140S, 88140SC

Individual tapes; P/N 9164-0156, 9164-0127, 9164-0211, 9164-0212

Revision Numbers involved: X0XXX-XXXX through X4XXX-XXXX

TITLE: TAPE CARTRIDGE REPLACEMENT

SYMPTOM: Tape cartridges purchased prior to October 1, 1983, or cartridges having a revision number with a second digit of "4" or lower stamped on the metal back plate (for example, X4XXX-XXXX) are subject to the following failures.

- Data loss, may result in auto sparing or verify failures.
- Shortened tape life.
- Autoload failures, cartridge fail LED may be on.
- Cartridge may unload during a read or write with a possible off tape status.

These failures are caused by a white dust that can be released from the tape. This dust collects on the cartridge guide pins, tensioning belt, and the recording surface of the tape and can cause both read and write errors. The contamination can also collect on the tape drive heads.

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9320-4766 (1/83)

HEWLETT PACKARD

7911P/R-15

SERVICE NOTE

Supersedes: NONE SUPERSEDES:

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure ☐	Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X

SERVICE INVENTORY	Return for update ☐	Use as is ☐
	Return for salvage ☐	See text ☒

WARRANTY EXTENDED UNTIL: N/A

TITLE:NEW FIRMWARE FOR 7911 P/R DISC DRIVES (REV 5.0, P/N 07914-19003)

SYMPTOM: NEW FIRMWARE IS BEING IMPLEMENTED IN 7911 P/R DISC DRIVES BEGINNING WITH SERIAL PREFIX 2429. THIS FIRMWARE (REV. 5.0) WILL PROVIDE THE FOLLOWING ENHANCEMENTS.

1. READ FULL SECTOR WILL BE IMPLEMENTED. THIS COMMAND EXISTS ON "EXRSI2" AS RF SECTOR. EXECUTING RF SECTOR WILL RETURN THE HEADER BYTES, THE DATA BYTES, THE CRC BYTES, AND ECC BYTES OF THE SPECIFIED SECTOR.

2. IN MR5, RUN TIME INFORMATION (RUN LOG) WILL BE REPORTED DIFFERENTLY THAN ERT TEST INFORMATION. CORRECTABLE ERRORS WILL NO LONGER BE COUNTED DURING DATA TRANSFERS. IN ADDITION, RECOVERABLE ERRORS WILL BE COUNTED BUT NOT HAVE THEIR ADDRESSES LOGGED. THIS MEANS THAT THE RECOVERABLE ERROR COUNT WILL APPEAR WHERE THE CORRECTABLE ERROR COUNT USED TO APPEAR IN THE "EXRSIZ" PRINTOUT. MARGINAL RECOVERABLE ERROR AND UNRECOVERABLE ERROR HANDLING WILL BE UNCHANGED.

ERROR TYPE:	DEFINITION:	RUN LOG:	ERT LOG:
CORRECTABLE	CORRECTED BY ECC	IGNORED	COUNTED
RECOVERABLE	RECOVERED BY ONE RETRY	COUNTED	ADDRESS RECORDED
MARGINAL	RECOVERED BY MORE THAN ONE RETRY	ADDRESS RECORDED	ADDRESS RECORDED
UNRECOVERABLE	NOT RECOVERED IN 800 MSEC	ADDRESS RECORDED	ADDRESS RECORDED

3. INCREASES THE DEFAULT RETRY TIME TO 800 MSEC FROM 100 MSEC. THIS ALLOWS FOR A MORE AGGRESSIVE READ OFFSET DURING RETRIES.

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HW/sg

9320-4766 (1/83)

HEWLETT PACKARD

4. ADDS AN INITIALIZE MEDIA OPTION WHICH ONLY WRITES THE MAINTENANCE TRACKS AND LEAVES THE USER DATA ALONE. IN "EXRSI2", INIT MEDIA HAS BEEN MODIFIED TO GIVE THE FOLLOWING CHOICES:

   I= INITIALIZE MAINTENANCE TRACKS ONLY. (THIS IN NO LONGER PHYSICAL FORMAT)
   P= RETAIN ONLY PRIMARY SPARES
   B= RETAIN PRIMARY AND SECONDARY SPARES

5. REWRITES THE SPARE SECTOR ON A GIVEN TRACK IF A READ RETRY IS NECESSARY. THIS WILL PREVENT A LOW AMPLITUDE SPARE SECTOR FROM INTERFERING WITH THE PLL CIRCUITRY.

6. CHECKS CRC AFTER A WRITE. THIS CHECKS FOR OSCILLATOR FAILURE ON THE DMA BOARD. IF THERE IS A FAILURE, DERROR 106 (OR 6A IN HEX) WILL BE GENERATED.

7. THE DRIVE WILL REQUEST RELEASE TO UPDATE THE MAINTENANCE TRACKS AFTER EVERY FAULT OR UNCORRECTABLE ERROR DURING RUN TIME. THIS WILL PREVENT USEFUL SERVICE INFORMATION FROM BEING LOST IN RAM IF THE DRIVE IS POWERED DOWN OR CLEARED.

8. DERROR'S 10, 11, AND 12 HAVE BEEN ELIMINATED AND THE CAUSE OF DERROR 13 HAS BEEN CHANGED TO:

   WHEN CHECK WAS MADE OF THE SECTOR HEADER READ FROM THE DISC, THE FIRST BYTE (STATUS) AND THE SIXTH BYTE (SPARE) DID NOT CONTAIN SECTOR NUMBERS POINTING TO THE SAME SECTOR.

   SUSPECT HARDWARE FOR THIS ERROR IS 1.) READ/WRITE PCA 2.) DMA PCA

ACTION: THIS IS A NON-MANDATORY CHANGE, HOWEVER ALL FSI SHOULD BE ROLLED TO THE NEW FIRMWARE. THE NEW EPROM KIT IS 07914-10003 AND THE EXCHANGE KIT IS 07914-19003.

THE KIT, 07914-19003, WILL BE SUPPLIED THROUGH CPC BLUE STRIPE EXCHANGE PROGRAM. ALL FSI IS TO BE UPDATED TO 07914-19003 AS SOON AS POSSIBLE. ALL EXCHANGE EPROMS ARE TO BE RETURNED TO CPC WITHIN 90 DAYS.

THE FOLLOWING IS A LIST OF THE INDIVIDUAL EPROMS AND THEIR "U" NUMBER ASSIGNMENTS ON THE MPU PCA. THE INDIVIDUAL EPROMS ARE NOT ORDERABLE.

07914-8X041	U241
07914-8X042	U261
07914-8X043	U271
07914-8X044	U291
07914-8X045	U2101
07914-8X046	U121

USING THE CS/80 REV COMMAND, THE NUMBERS RETURNED ARE 5.0 FOR ALL THE EPROMS.

7911-16

SERVICE NOTE

Supersedes: None

FOAM SHIPPING SPACER

PRODUCTS AFFECTED:
7911P
7912P
7914P

SERIAL PREFIXES INVOLVED:
2445 and greater 7914
2444 and greater 7911/12

PART AFFECTED:
5041-1305

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	N/A		

SYMPTOM: 791X pod drives show contact between the power module casing and the disc mechanism when subjected to severe shock during shipping. This contact may damage the RFI stripping on the power module.

CAUSE: Pods are shipped on their side which somewhat distorts the mechanism's shock mounts. Additional distortion caused by shock allows contact between the power module and disc mechanism.

SOLUTION: A foam shipping spacer (PN. 5041-1305) has been installed between the power module (PN 07912-60028) and the disc mechanism (PN 0791x-60100) on all 791x P Disc Drives with serial perfix 2444 (or greater). This modification will significantly reduce shock and vibration to the fragile disc mechanism as well as eliminate the possibility of contact between the power module and the mechanism. A label (PN 5180-0526), attached to the power supply, has also been added which reads:

CAUTION
FOAM SHIPPING BLOCK MUST BE REMOVED BEFORE DRIVE POWER ON.

ATTENTION
LE BLOQUE POLY-ETHYLENE UTILISE DURANT L'ENVOI DOIT ETRE ENLEVE AVANT LA MISE EN MARCHE DE L'APPAREIL.

VORSICHT
DER VERSANDBLOCK MUSS VOR INBETRIEBNAHME DES GERAETES ENTFERNT WERDEN.

ACTION: Remove the foam spacer during the installation of the 791X P Disc Drive. It is visible from the top of the drive when the flip top cover is removed. This should only take a second when unlocking the two shipping locks on the disc mechanism. Retain the foam spacer for reuse should the drive be shipped again.

JH/sg

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12/84-48

9320-4766 (1/83)

HEWLETT PACKARD

7911P/R-17

S E R V I C E N O T E

Supersedes:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	0.5hr.		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	March 31, 1986		

MODEL NAME AND NUMBER:
791X Standard and Opt.
015 Disc Drives

PART NUMBERS INVOLVED:
07914-10003
07914-19003
07914-89042

SERIAL NUMBERS INVOLVED:
7911/12 From: 2429
To: 2503
7914 From: 2430
To: 2504

TITLE: 791X FIRMWARE REVISION 5.1

SYMPTOM: On standard and option 015 (220v,50Hz) drives with MR5 firmware a Derror 229 (sector miscompare) can occur during a disc-to-tape pushbutton backup.

CAUSE: If a read retry occurs during a pushbutton backup, the firmware improperly accesses the spare table in RAM to rewrite the spare sector. Therefore, instead of the spare sector being rewritten logical sector 0 is rewritten with a physical sector 0 in the header. Since physical sector 0 does not exist, a sector miscompare (D229) occurs.

SOLUTION: The solution to this problem is firmware revision 5.1. This eliminates the rewrite of the spare sector during disc-to-tape backups. The spare sector is still rewritten if an uncorrectable data error occurs during normal disc operation.

The 5.1 revision is implemented on PROM #2 (U261). Therefore, drives with MR5 can be be upgraded by replacing PROM #07914-89042 with PROM #07914-89142. This upgrade is strongly recommended for all drives upgraded to MR5 and for drives with serial prefixes 2430 to 2504 (or 2429 to 2503 for 7911/12 drives.

MR5.1 firmware kits 07914-10103 (new) and 07914-19103 (exchange) are available through CPC. These kits replace MR5 kits 07914-10003 and 07914-19003, respectively.

SH/sg

3/85-48

Note: All FSI of MR5 kits should be returned to CPC for credit. On single part replacement, the old PROM can be scrapped. For a full upgrade, the old PROMs should be returned to CPC.

Once the firmware has been upgraded, the following procedure should be followed if a Derror 229 has occurred:

1. Do a full volume RO ERT.
2. Check Fault Log for any D229s.
3. If a D229 exists, do a WTR ERT on that sector.
4. Repeat steps 1-3 until all D229s are gone.
5. Perform a tape restore to the disc since any data in D229 sectors has been lost.

WARRANTY: DMD will accept extended warranty, 02G, as indicated below.

```
**************************************************************************
*       PARTS:  07914-89142   EPROM-MEMORY                               *
*                                                                        *
*       LABOR:  1/2 hour                                                 *
*                                                                        *
*       TRAVEL:  None                                                    *
*                                                                        *
*   When filling out the CSO, enter 20022 in the service code field.     *
**************************************************************************
```

7912 P/R-02

SERVICE NOTE

Supersedes:

7912P/R Disc/Tape Drive

All Units With Serial Number Prefix 2205A and Below

Mandatory MPU Firmware Update

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☒		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	.3 hrs		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☒		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '83		

SYMPTOM: Mandatory next site visit update of MPU firmware in all 7912P/R disc drives with a serial number prefix of 2205A and below.

CAUSE: The latest revision MPU firmware contains fixes for many low level bugs. In addition to these fixes, the new TIB PCA (07908-6X241) requires updated firmware (see service note 7912P/R-03). A mandatory update is being implemented because of the wide number of symptoms. No single symptom, however, requires a mandatory update.

SOLUTION: On the next visit to the customer's site the CE should update the MPU firmware by installing a 07912-19004 exchange EPROM kit. The revision level of MPU firmware can be checked by noting the individual EPROM's part numbers. The 07912-19004 EPROM KIT firmware will have the following numbers:

U241 - 07912-89020
U261 - 07912-89021
U271 - 07908-89059
U291 - 07908-89060
U2101 - 07908-89061
U121 - 07908-89062

Note: These EPROM's are not individually replaceable. The EPROM kit (which includes all six EPROMS) must always be ordered.

LR/sg (cont) 3/82-48

HEWLETT PACKARD

The MPU EPROM kit is now supplied through the Corporate Parts Center's (CPC, or div 15) Blue Stripe Exchange program. The Exchange EPROM kit part number is 07912-19004. Defective exchange kits should be returned to CPC/PCE (Div. 15) and NOT to CSD (Div. 50). All service kits must be updated with the 07912-19004 revision firmware.

Note: As prevously stated, the 07908-69241 TIB PCA requires 07912-19004 revision MPU firmware. However, the old revision TIB PCA (07908-69141) will work correctly with the new revision firmware. It's not necessary to update the TIB PCA when new firmware is installed.

DMD will accept extended warranty (02G) as follows:

Parts - 07912-19004 Exchange EPROM Kit. (DMD will not accept warranty billings for new EPROM kits 07912-10004. Only the exchange kit will be accepted.)

Labor - .3 hours

Travel - None - update should be done during the CE's next site visit.

```
**********************************************************************
* NOTE: When completing the Customer Support Order (CSO) form       *
*       the service code block should be filled in with: "0002"      *
*       This code will allow DMD to monitor the implementation       *
*       of this service note and prevent rejection of warranty       *
*       billing.                                                     *
**********************************************************************
```

7912P/R-03

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure X		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	.7 hrs		
PARTS:	X		
TRAVEL:	X		
SERVICE	Return for update X		Use as is ☐
INVENTORY	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '83		

7912P/R Disc/Tape Drive

All Units With Serial Number Prefix 2205A and Below

Cartridge Tape Read or Certify Errors

SYMPTOM: Falsely reported uncorrectable tape data errors may occur during a tape read, initialize, or certify. In some cases an uncorrectable tape data error will be followed by an unlocatable block. Although the error is not unrecoverable, the tape subsystem will report it as such.

CAUSE: Tape media defects (dropouts) are normally corrected by the drive's error correction circuitry (ECC). If the ECC cannot correct the error caused by a dropout the defective block will be spared during the tape certify. However, marginal areas on the tape are not always identified by the certify operation. When a read was attempted in an area with a defect, the block would be seen as uncorrectable. Recovery from the error would not occur until well into the next block, rendering that block unlocatable. If the error was detected during normal operation, the location will be in the RUN LOG.

LR/sq

(cont.)

3/82-48

HEWLETT PACKARD

The Tape Interface Board (TIB) and the Microprocessor PCA's firmware (MPU EPROM Kit) have been modified to prevent the false detection of uncorrectable data. In most cases these modifications will allow recovery of previously written customer data.

SOLUTION: When an unrecoverable tape read error occurs, the CE must update the following assembly:

Tape Interface Board (TIB)
****07908-69241****

The 07908-69241 replaces the 07908-69141. All 07908-69141 TIB PCA's currently in field service inventory (FSI) must be returned to CSD for update.

Important Note:
The 07908-69241 TIB PCA requires the drive to have 07912-19004 (or above) revision MPU firmware. The MPU firmware update is being implemented on all drives with a serial number prefix of 2205A and below. Refer to service note 7912-02 (Mandatory MPU Firmware Update) for details on identifying updated firmware.

DMD will accept warranty as follows:

Parts - 07908-69241 exchange TIB PCA

Labor - .7 hours

Travel - Yes

This service note should be implemented only on failure.

```
**********************************************************************
* NOTE: When completing the Customer Support Order (CSO) form       *
*       the service code block should be filled in with: "0003"     *
*       This code will allow DMD to monitor the implementation      *
*       of this service note and prevent rejection of warranty      *
*       billing.                                                    *
**********************************************************************
```

7912P/R-04

SERVICE NOTE

Supersedes:

7912P/R Disc/Tape Drive

Special TIB PCA Update

Drive Serial Numbers
2206AXXXXX through 2209AXXXXX

Parts Affected: 07908-60241
date code E-2206 only.

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure ☒	Information Only ☐

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	.7 hrs		
PARTS:	X		
TRAVEL:	X		

SERVICE	Return for update ☒	Use as is ☐
INVENTORY	Return for salvage ☐	See text ☐

WARRANTY EXTENDED UNTIL: 15 April '83

SYMPTOMS: 1. Test errors CO (destructive write fault on fault latch) or DA (cannot read spares table on maintenance tracks) may occur during a tape error rate test or certify.

2. Test error 28 (TIB to DMA write path error) incorrectly reported by self-test.

3. When performing a tape read, the TIB state machine may jump into an infinite loop and cause a time-out to be returned.

CAUSE: The symptoms described above were created on the first implementation of the 7908-60241 TIB PCA (date code E-2206). None of these symptoms occur on the 07908-60141 TIB. Because this design error was discovered soon after the 07908-60241 was introduced to production, only approximately 80 7912P/R disc drives are affected by this service note, all of these drives were shipped from DMD from March 1 to March 21,1982.

LR/sa (cont.) 2-82/48

HEWLETT PACKARD

SOLUTION: The part number of the TIB PCA will remain 07908-69241. The previously described changes will be indicated by a TIB date code of E-2210. All field service inventory will be updated to date code E-2210.

Should one of the symptoms described above occur and the drive serial number prefix is 2206A through 2208A, the CE should replace the TIB PCA. This service note should be implemented only on failure.

DMD will accept extended warranty (02G) as follows:

Parts: 07908-69241
Labor: .7 hours
Travel: Yes

Important Note:
None of the three symptoms described in this service note apply to the 07908-69141 TIB PCA. Refer to service note 7912 P/R-03 for information.

****
* NOTE: When completing the Customer Support Order (CSO) form *
* the service code block should be filled in with: "0004; *
* This code will allow DMD to monitor the implementation *
* of this service note and prevent rejection of warranty *
* billing. *
****

7912P/R-05

SERVICE NOTE

Supersedes: None

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure X		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	.3 hr.		
PARTS:	X		
TRAVEL:	no		
SERVICE	Return for update X		Use as is ☐
INVENTORY	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	May 1983		

Models Affected: 7911P/R
and 7912 P/R

Serial prefixes involved:
less than 2220

Part numbers involved:
07912-60004-R/W PCA
07912-6X001-Servo PCA

Write-off-track errors

Symptoms: Changes to the read/write and servo boards will eliminate disc write-off-track errors. The part number of the servo board changes from 07912-6X001 to 07912-6X121. The part number for the read/write board changes from 07912-6X004 to 07912-6X104. The new servo board (07912-6X121) is not compatible with the old read/write board (07912-6X004).

Cause: Write-off-track errors are caused by crosstalk between the servo head and data heads. The changes to the read/write and servo boards alter timing between the two, so crosstalkdoes not affect the servo system or data transfers.

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HEWLETT PACKARD

Action: This service note should be implemented on failure only of the 07912-6X001, 07912-6X004 or 07912-6X100.

Use the following matrix for repair:

Failing Part	Parts Used For Repair
07912-6X001	07912-6X121 and 07912-6X104
07912-6X004	07912-6X104 and 07912-6X121
07912-6X100 or 07911-6X100	07912-6X100 or 07911-6X100 and 07912-6X121* and 07912-6X104*

Note: If the disc drive has the updated boards (07912-6X104 and 07912-6X121) already in place, it is not necessary to replace these additional boards.

Caution: There is the possibility of causing write-off-track errors if the 07912-6X121 is placed in a drive with the 07912-6X004.

Warranty - extended

Labor - .3 hr.

Parts - Yes

Travel - No

7912P/R-06

SERVICE NOTE

Supersedes: 7912P/R-02

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	0.5hr		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☒		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	August, 1983		

7912 P/R Disc/Tape Drive

All units with serial number prefix below 2230

MPU Mandatory Firmware Update

SYMPTOM: Mandatory next site visit MPU firmware update of all 7912 discs with serial number prefix below 2230.

CAUSE: The predominant reason for this firmware update has been tape certification failures due to a "no data found" error. On many systems this error is not reported, but the system indicates "uninitialized media" when the tape initialization (format/certify) aborts.

This firmware revision also forces the ERT log to be updated at tape certification termination. This occurs whether the termination is normal or not.

This new firmware revision also corrects many low-level bugs that are transparent to the user.

SOLUTION: On the next customer site visit, update the firmware by replacing the 6 EPROMS with the new exchange EPROM kit. The part number of the new exchange kit is 07912-19005. This kit is available from CPC/PCE on the Blue Stripe Program. Old EPROMS should be returned for credit to CPC/PCE (Div. 15).

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HEWLETT PACKARD

Following is a list of part numbers of individual EPROMS and the "U" number corresponding to their location on the MPU board (07912-6X011). Enclosed with each kit is a label to signify the drive has been updated. Place this label next to the serial number tag.

NOTE: These individual parts are NOT available. The entire kit must be ordered from CPC, p/n 07912-19005.

07912-89024	U241
07912-89025	U261
07908-89068	U271
07908-89069	U291
07908-89070	U2101
07908-89071	U121

NOTE: This service note supersedes S/N 7912P/R-02.

NOTE: The 7908 EPROM kit cannot be used in the 7912.

DMD will accept extended warranty (02G) as follows:

Parts - 07912-19005 Eprom Exchange Kit
Labor - .5 hours
Travel - no travel will be accepted

DMD will not accept extended warranty for NEW EPROM kits.

****
*NOTE: When completing the customer support order (CSO) *
* form the service code block should be filled in *
* with: "0006". This code will allow DMD to monitor*
* the implementation of this service note and pre *
* vent rejection of warranty billing. *
****

7912P/R-07

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units [X]		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM Normal Call ☐
	On Failure [X]		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	1.5 hr		
PARTS:	no		
TRAVEL:	1.3 hr		
SERVICE INVENTORY	Return for update [X]		Use as is ☐
	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	November, 1983		

MODELS AFFECTED: 7912P/R

SERIAL PREFIXES INVOLVED:

7912P/R 2248 AND BELOW

PART NUMBERS INVOLVED:

07908-6X140 TAPE MECHANISM
07908-69340 TAPE MECHANISM

TAPE MECHANISM FAILURES

SYMPTOMS:

1. TAPE CERTIFY/INITIALIZE/FORMAT FAILURES

   THE TAPE INITIALIZATION ROUTINE IS A WRITE THEN READ ERROR RATE TEST, WITH SPARING FOR UNCORRECTABLE AND UNLOCATABLE ERRORS. THIS PROCESS CAN BE TERMINATED IF:

   A. ALL SPARES ARE USED.
   B. THE MAINTENANCE TRACK OVERLOWS WITH PERMANENT ERRORS.

   THESE FAILURES INDICATE THAT THE TAPE DRIVE HEAD IS NOT WRITING OR READING THE DATA CORRECTLY. ONLY OCCASIONALLY WILL THE TAPE CARTRIDGE BE THE CAUSE OF THESE FAILURES.

   IF THE INITIALIZATION PROCESS TERMINATES IN ERROR ALL SYSTEMS WILL REPORT "UNINITIALIZED MEDIA". ADDITIONAL INFORMATION ON THE FAILURE WILL BE DISPLAYED ON SOME SYSTEMS.

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HEWLETT PACKARD

7912P/R-07

2. UNRECOVERABLE DATA ERRORS REPORTED ON TAPE UNIT.

UNRECOVERABLE DATA ERRORS WILL BE REPORTED BY THE SYSTEM DRIVER OR THE SYSTEM UTILITY, FROM THE CS80 STATUS WORDS:

3000(MPE) SYSTEMS - LISTLOG2 WILL HAVE AN UNRECOVERABLE ERROR BIT SET IN THE FOURTH FIELD OF THE DEVICE STATUS WORDS.

1000(RTE) SYSTEMS - AN UNRECOVERABLE DATA ERROR WILL BE REPORTED TO THE TERMINAL, WHEN IT OCCURS.

250 SYSTEMS - AN UNRECOVERABLE ERROR BIT WILL BE SET IN THE DISC STATUS RETURNS.

THE TAPE RUN LOG WILL ALSO CONTAIN INFORMATION ABOUT UNRECOVERABLE DATA ERRORS. THE RUN LOG WILL GIVE THE COUNT OF BOTH UNLOCATABLE OR UNCORRECTABLE DATA ERRORS. THESE TWO ERROR TYPES ARE THE SUBSETS OF UNRECOVERABLE ERRORS.

CAUSE: TAPE DRIVES WITH FAULTY READ/WRITE HEADS OR R/W ELECTRONICS, CANNOT RECOVER DATA PROPERLY.

ACTION: IF TAPE INITIALIZATION FAILS OR UNRECOVERABLE ERRORS ARE REPORTED FREQUENTLY, REPLACE THE TAPE DRIVE WITH A TAPE DRIVE WITH A NEW PART NUMBER. A 07908-6X340 WILL HAVE AN IMPROVED READ/WRITE HEAD CONTOUR AND R/W ELECTRONICS. UPON FAILURE REPLACE 07908-6X140 WITH 07908-69340.

****

CAUTION: TAPE INITIALIZATION FAILURES REQUIRE REV. F FIRMWARE BE INSTALLED IN THE DISC. SEE SERVICE NOTE:

7912P/R-06

NOTE: ANY INITIALIZATION FAILURES REQUIRE UPGRADE OF THE TAPE MECHANISM. IF REV.F, p/n07912-19005, HAS NOT BEEN INSTALLED, THIS IS IMMATERIAL. REPLACE THE TAPE MECHANISM AND UPGRADE THE FIRMWARE.

****

7912P/R-07

DMD WILL ACCEPT EXTENDED WARRANTY (02G) AS FOLLOWS:

PARTS - NO
LABOR - 1.5 HOURS
TRAVEL - YES

DMD WILL NOT ACCEPT EXTENDED WARRANTY FOR TAPE MECHANISMS. ANY MECHANISMS REPLACED FOR THE FAILURES DETAILED IN THIS NOTE SHOULD BE RETURNED TO CSD FOR CREDIT. ORDER A REPLACEMENT AS FSI INCREASE, WITH THE COMMENT "!UPDATE". RETURN 07908-6X140 AS A FSI DECREASE. IT WILL BE CROSSREFERENCED TO A 07908-69340.

NOTE: WHEN COMPLETING THE CUSTOMER SUPPORT ORDER (CSO) FORM THE SERVICE CODE BLOCK SHOULD BE FILLED IN WITH: "0007"

THIS CODE WILL ALLOW DMD TO MONITOR THE IMPLEMENTATION OF THIS SERVICE NOTE AND PREVENT REJECTION OF WARRANTY BILLING.

7912P/R-08

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units [X]		Only Units on Agreement [ ]
PERFORM:	Immediately [ ]		At PM/Normal Call [ ]
	On Failure [X]		Information Only [ ]

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:	X		
TRAVEL:			X

SERVICE INVENTORY	Return for update [ ]	Use as is [ ]
	Return for salvage [ ]	See text [X]

WARRANTY EXTENDED UNTIL: April, 1988

PRODUCTS AFFECTED: 7911 P/R
7912 P/R

7912 SERVO AND MECHANISM COMPATIBILITY

SERIAL DATE CODE AFFECTED - 2301 AND BELOW

SYMPTOM: The 791X-6X200 mechanisms are not compatible with 7912 servo PCA's (07912-6X121 or 07912-6X001).

If a 07912-6X121 or 07912-6X001, servo PCA, is used with a 0791X-6X200 it is possible to experience the following errors (DERRORS are located in the fault log and TERRORS are output on the self-test display.)

1. Uncorrectable data errors.
2. Sector compare error - DERROR 229.
3. Speed not OK error - DERROR 64, bit 5. (Do not confuse this with TERROR 97 - disc unable to spin-up, which indicates a defective speed transducer.)
4. Servo timing pulse register did not change - DERROR 96.

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HEWLETT PACKARD

CAUSE: Differences between the 7912 and the 7914 servo PCA have made the 7914 servo PCA less susceptible to noise on the servo lines than the 7912 servo. The 7914 servo PCA (07914-6X001) is used to test mechanisms, with the following part numbers - 07911-6X200, 07912-6X200, 07914-6X100. Therefore, it is possible for any of these mechanisms to operate normally if a 07914-6X001 servo PCA is used, even though the noise level may be high enough to affect the 07912-6X121.

ACTION: This problem will occur only with the old servo PCA's. The configuration which causes the errors listed above can only occur in the field. Therefore, the only action required is that the 07912-6X001 or 07912-6X121 be replaced with the new servo, 07914-6X001, whenever a new mechanism replaces an old one (0791X-6X100).

COMPATIBLE REPLACEMENT COMBINATIONS:

Servo	Mechanism
07912-6X121	07911-6X100 or 07912-6X100
07914-6X001	0791X-6X100 or 0791X-6X200

INCOMPATIBLE COMBINATION:

Servo	Mechanism
07912-6X121	07911-6X200 or 07912-6X200 or 07914-6X100

NOTE: It is not necessary to update servo PCA's (07912-6X001 or 07912-6X121) in existing drives unless a repair is made which affects compatibility.

Warranty will be extended to cover parts only.

* *
* NOTE: When completing the customer support order (CSO) *
* form, the service code block should be filled in *
* with "20004". This code will allow DMD to monitor *
* implementation of this service note. *
* *

7912P/R-09

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units X		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure X		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:	Update only for existing stock		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text X
WARRANTY EXTENDED UNTIL:	August, 1983		

PRODUCTS AFFECTED:
7911 P/R
7912 P/R

SERIAL PREFIXES AFFECTED:
2251 AND BELOW

SPEED TRANSDUCER ROLLOVER

PROBLEM: Speed transducers have exhibited a higher failure rate than anticipated. This is also a problem with speed transducers in the product support packages. Defective speed transducers will cause self-test failure "9", with an error code "97" (disc unable to spinup). Some discs with early firmware may not complete self-test and/or the motor may turn off after a few minutes of operation.

CAUSE: The speed transducer, positioned beside the spindle, may be defective.

ACTION: If these symptoms are experienced replace the speed transducer. The current part number is 07912-60111. An old transducer (07912-60031) can be used but may exhibit the same symptoms. Ensure that a 07912-60111 has been tried before replacing the disc mechanism.

A properly functioning speed transducer will have a TTL level pulse measured between the green and black wires of the connector to the motherboard.

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HEWLETT PACKARD

ACTION cont.

DO NOT change the disc mechanism for these symptoms until the following actions are taken. First, replace the speed transducer. Check the spindle lock to insure it is disengaged. Also, check the motor assembly. It could be an occasional cause of speed problems, and can be replaced without replacing the disc mechanism. Speed problems may also be the result of a defective servo, read/write or motherboard. Please check these PCA's also. All speed transducers in field stocking inventory with old part numbers (p/n 07912-60031) should be replaced with new ones (p/n 07912-60111).

NOTE: Do not upgrade customer units, except on failure.

NOTE: Return current field stock part number 07912-60031 to CPC for credit and order an update, part number 07912-60111.

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7912P/R-10

S E R V I C E N O T E

Supersedes: None

APPLIES TO:	All Units ☐		Only Units on Agreement ☒
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	X		
PARTS:	07908-69340		
TRAVEL:	X		
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:			

TAPE DESPOOLING

UNITS AFFECTED: 7908 /11/12/14 P/R
With Tape Drives

SERIAL NUMBER
PREFIXES INVOLVED: 2301 To 2310

PARTS AFFECTED: 07908-6X340
Date Code 2237 To 2311

SYMPTOM: Tape is despooled (detached from hub) during autoload. Despooling occurs only if the unit is powered on with the cartridge in place. This symptom may oocur intermittently.

CAUSE: A specification change combined with a design fault in the tape mechansim caused despooling. (Note: an update to the tape mechanism has correted the problem.)

ACTION:
1. On failure, replace tape drives which cause tape despooling with an updated unit. The update has been performed if the date code on the tape drive MPU (on rear of tape drive, rightmost of the three large IC's) is T5PXXXX.
2. If it is not possible to replace the tape drive immediately have the customer insert the tape cartridges only after power on.

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9320-4766 (1/83)

HEWLETT PACKARD

DMD will accept extended warranty (02G) as follows:

Parts - 07908-69340, tape drive.
DMD will not accept warranty for new tape drives 07908-60340.

Labor - 1 hour

Travel - Yes

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                                                                       *
*                              NOTE:                                    *
*                                                                       *
*        When completing the Customer Support Order (CSO)               *
*        form, the service code block must be filled in                 *
*        with "20007". Failure to use the service code                  *
*        will result in rejection of the warranty billing.              *
*                                                                       *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7912P/R-11B

SERVICE NOTE

Supersedes: 7911/12P/R-11

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	1 hour		
PARTS:	yes		
TRAVEL:	no		
SERVICE	Return for update ☒		Use as is ☐
INVENTORY	Return for salvage ☐		See text ☐
WARRANTY EXTENDED UNTIL:	July 1984		

Products Affected: 7911P/R
7912P/R

Servo Failures Caused by Backwards Servo Code

Serial Date Prefixes Involved:
2209 and below

Parts Affected:

07912-6X001	Servo PCA (A9)
07912-6X121	Servo PCA (A9)
07911-6X100	7911 Mechanism
07911-6X200	7911 Mechanism
07912-6X200	7912 Mechanism
07912-6X100	7912 Mechanism
07914-6X001	7914 Servo PCA

Symptom: If a 07914-6X001, servo PCA, is placed in a disc drive with reverse servo code the following symptom will occur:

Self test will fail with a "9." and any combination of the following error codes: 90, 96, 97 and Ab.

Do not confuse these symptoms with those exhibited by a drive with a faulty speed transducer. See service note 7912P/R-09.

LR/sg

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HEWLETT PACKARD

Cause: The servo code on some drive mechanisms was written backwards which changes the timing between negative and positive peaks of the servo code. This timing can cause the 7914 servo electronic PCA (07914-6X001) to ignore the servo code di-bits. This happens because the 7914 servo PCA detects a servo di-bit by sensing both the negative and positive peaks of the servo signal. The older servo PCA's, 07912-6X001 and 07912-6X121, are not susceptible to this problem because they utilized only a positive peak detector.

Production safeguards have been implemented on mechanisms with serial date prefixes 2210 and greater to ensure the servo code is written properly.

Action: First check to make sure the errors are not caused by;

a) a faulty speed transducer
b) shipping locks in ship position
c) open fuses on the servo PCA

Then, replace the disc mechanism with a 0791X-69100, date code greater than 2200, or a 0791X-69200.

DMD will pay extended warranty for:

Parts - yes 0791X-69100 or 0791X-69200
Labor - 1 hr.
Travel - no

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*                        N O T E :                              *
*                                                               *
*   When completing the Customer Support Order (CSO) form       *
*   the service code block must be filled in with "20008"       *
*   Failure to use the service code will result in rejec-       *
*   tion of the warranty billing.                               *
*                                                               *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7912P/R-12

SERVICE NOTE

Supersedes: None

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☒		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '84		

7911/12 Disc/Tape Drive

Serial Number Prefix Less Than 2326

TITLE: Mandatory Firmware Update to PEP (P/N 07914-19002)

SYMPTOM: All 7911/12 discs produced prior to the 2326 prefix should be updated to PEP. Drives with a serial prefix of 2326 or greater are manufactured with the new firmware and will not require updating.

CAUSE: PEP (performance enhancement) firmware introduces significant improvements in 7911/12 disc reliability and performance. This firmware is backwards compatible and is common to the 7911/12/14. The outstanding result of PEP firmware is a 10-15% increase in drive performance. The additional performance is achieved by changes to the firmware code hierarchy. For often received commands (read and write), the code has been simplified.

There are also many changes in PEP firmware that increase reliability. The reliability enhancements are listed below:

1. "8.dd"
Diagnostics, initiated by DIAG1 from the External Exerciser, or from MPU switches, will now return an "8.dd" error code only when an uncorrectable error is encountered by the full volume error rate test (ERT). Previous firmware reported an "8.dd" when either an uncorrectable or correctable error was discovered. (The equivalent error logged in the fault log will be TERROR 221. The ERT log will contain the location and type of error of all errors encountered by the ERT, regardless of firmware revision.)

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HEWLETT PACKARD

FOR MORE INFORMATION, CALL YOUR LOCAL HP SALES OR SERVICE OFFICE or East (201) 265-5000 • Midwest (312) 255-9800 • South (404) 955-1500 • West (213) 970-7500 or (415) 968-9200 OR WRITE, Hewlett-Packard, 1820 Embarcadero, Palo Alto, California 94303. IN EUROPE, CALL YOUR LOCAL HP SALES or SERVICE OFFICE OR WRITE, Hewlett-Packard S.A., 7, rue du Bois-du-Lan, P.O. Box, CH-1217 Meyrin 2 - Geneva, Switzerland. IN JAPAN, Yokogawa-Hewlett-Packard Ltd., 1-27-15, Yabe Sagamihara City, Kanagawa Prefecture, Japan 229.

2. Timeout
   The possibility of microprocessor hangs as a result of erroneous PHI chip interrupts is eliminated. This will decrease the causes of channel time-outs.

3. Tape Restore Errors
   The busy light will flash at the end of a push-button restore if an uncorrectable error has occurred.

4. End of File
   Error conditions are now less likely to affect the recognition of end of file on the tape.

ACTION: At next site visit, replace the existing firmware with PEP, p/n 07914-19002. The following is a list of the part numbers of the individual EPROMS in the kit versus their "U" number assignments on the microprocessor PCA. The individual EPROMS are not orderable.

07914-89031	U241
07914-89032	U261
07914-89033	U271
07914-89034	U291
07914-89035	U2101
07914-89036	U121

The kit, 07914-19002, will be supplied through CPC (Div. 15) Blue Stripe exchange program. All FSI is to be updated to PEP as soon as possible.

NOTE: On dual controllers (option 001) update only the disc MPU (A3).

DMD will accept extended warranty (02G) as follows:

Parts - 07914-19002
Labor - no
Travel - no

```
* * * * * * * * * * * * * * * * * * * * * * * * * * *
*  NOTE:                                              *
*  When completing the Customer Support Order (CSO)   *
*  form, the service code block must be filled in     *
*  with "20009". Failure to use the service code      *
*  will result in rejection of the warranty billing.  *
*                                                     *
* * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7912P/R-13

SERVICE NOTE

Supersedes: None

AFFECTED PRODUCTS: 7911P/R
7912P/R
7914P/R

AFFECTED SERIAL PREFIX: 2330

PART NUMBER INVOLVED: 07912-60111

7911/12/14 SPEED SENSOR ASSEMBLIES
(SPEED TRANSDUCERS)

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☒		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	Yes		
PARTS:	07912-60111		
TRAVEL:	Yes		
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	May 1, 1984		

SYMPTOM: Intermittent speed transducer failures resulting in self test error 9.97 (hex), which decodes as "disc not able to spin up."

CAUSE: Recent speed sensor assemblies with bad crimps at the motherboard connectors.

ACTION: Replace the speed sensor assembly P/N 07912-60111.

DO NOT replace a mechanism for this problem.

If the spin-up error continues see the "Guidelines For 7911/12/14 Mechanism Troubleshooting". (Support Update Supplement, May 13, 1983, #274, CE Handbook Update, October '83. 7911/12/14 Service Manual Update, October '83.)

DMD will accept extended warranty (02G) as follows:

Parts - 07912-60111
Labor - 0.5 hr.
Travel - Yes

* *
* NOTE: When completing the Customer Support Order (CSO) form, the service *
* code block must be filled in with "20013". Failure to use the *
* service code will result in rejection of the warranty billing. *
* *

LR/sg

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9320-4766 (1/83)

HEWLETT PACKARD

SOLUTION: All tapes prior to revision "5" should be returned by the customer to HP for replacement. The method of replacement is:

. UNITED STATES -
Return tapes to:
Hewlett Packard Company
Computer Supplies Operation
1326 Kifer Road
Sunnyvale, CA 94086
Contact CSO sales development (408 720-2343) for details and to request a pre-authorized return form. Any questions should be directed to Mark Manqueros at CSO, (408) 720-2433, COMSYS A500.

. HPSA -
Tape replacement will be handled by the sales force 09 group in each European country, with the SF09 managers acting as the contact person for questions. Replacements will be supplied to customers immediately following the return of defective cartridges. Dieter Heck, BBN x 2118, COMSYS 6017, will be coordinating the program and any questions that cannot be answered locally should be addressed to him.

. ICON -
The replacement will be handled locally by the Country Support Administration Manager and the ACEM's, with the ACEM's coordinating the replacement to distributors. Please contact them for details. If questions cannot be answered by the local contacts, please direct them to Joyce Smith, ICON (Div. 18), (415) 857-3707.

. CANADA -
Canadian customers received the same packet of information and preauthorization as United States customers, and certainly that replacement procedure will be supported by CSO. But due to customs regulations, shipping tapes to CSO across an international boundary is slow and complex. For these reasons, Canada will set up their own replacement program through the Canadian Parts Distribution Center, 2050. Customers should call one of the following numbers:

Manitoba and West	1-800-387-3154
Toronto	671-8383
Ontairo	1-800-268-6982
Quebec and East	1-800-387-3417

Any questions should be directed to Rob Young, COMSYS 2050.

HEAD CLEANING: Please encourage all customers to clean the head and capstan regularly; a minimum of once a week. Also, the cleaning procedure should be the first step in tape drive troubleshooting. For head/capstan cleaning procedures, refer to the Operating and Installation Manual (07908-90902 or 07912-90902), or the Operator Instructions (07908-90901 or 07912-90901) for details.

WARRANTY: . Tape replacement through CSO.
. Only revision "5", or greater tapes, will be supported by DMD. Warranty will not apply to failures caused by use of old revision (0 - 4) tapes after July, 1984.

7912P/R-15

SERVICE NOTE

Supersedes:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X

SERVICE	Return for update ☒	Use as is ☐
INVENTORY	Return for salvage ☐	See text ☐

WARRANTY EXTENDED UNTIL: N/A

TITLE: NEW FIRMWARE FOR 7912 P/R DISC DRIVES (REV 5.0, P/N 07914-19003)

SYMPTOM: NEW FIRMWARE IS BEING IMPLEMENTED IN 7912 P/R DISC DRIVES BEGINNING WITH SERIAL PREFIX 2429. THIS FIRMWARE (REV. 5.0) WILL PROVIDE THE FOLLOWING ENHANCEMENTS.

1. READ FULL SECTOR WILL BE IMPLEMENTED. THIS COMMAND EXISTS ON "EXRSI2" AS RF SECTOR. EXECUTING RF SECTOR WILL RETURN THE HEADER BYTES, THE DATA BYTES, THE CRC BYTES, AND ECC BYTES OF THE SPECIFIED SECTOR.

2. IN MR5, RUN TIME INFORMATION (RUN LOG) WILL BE REPORTED DIFFERENTLY THAN ERT TEST INFORMATION. CORRECTABLE ERRORS WILL NO LONGER BE COUNTED DURING DATA TRANSFERS. IN ADDITION, RECOVERABLE ERRORS WILL BE COUNTED BUT NOT HAVE THEIR ADDRESSES LOGGED. THIS MEANS THAT THE RECOVERABLE ERROR COUNT WILL APPEAR WHERE THE CORRECTABLE ERROR COUNT USED TO APPEAR IN THE "EXRSIZ" PRINTOUT. MARGINAL RECOVERABLE ERROR AND UNRECOVERABLE ERROR HANDLING WILL BE UNCHANGED.

ERROR TYPE:	DEFINITION:	RUN LOG:	ERT LOG:
CORRECTABLE	CORRECTED BY ECC	IGNORED	COUNTED
RECOVERABLE	RECOVERED BY ONE RETRY	COUNTED	ADDRESS RECORDED
MARGINAL	RECOVERED BY MORE THAN ONE RETRY	ADDRESS RECORDED	ADDRESS RECORDED
UNRECOVERABLE	NOT RECOVERED IN 800 MSEC	ADDRESS RECORDED	ADDRESS RECORDED

3. INCREASES THE DEFAULT RETRY TIME TO 800 MSEC FROM 100 MSEC. THIS ALLOWS FOR A MORE AGGRESSIVE READ OFFSET DURING RETRIES.

HW/sg

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HEWLETT PACKARD

4. ADDS AN INITIALIZE MEDIA OPTION WHICH ONLY WRITES THE MAINTENANCE TRACKS AND LEAVES THE USER DATA ALONE. IN "EXRSI2", INIT MEDIA HAS BEEN MODIFIED TO GIVE THE FOLLOWING CHOICES:

   I= INITIALIZE MAINTENANCE TRACKS ONLY. (THIS IN NO LONGER PHYSICAL FORMAT)
   P= RETAIN ONLY PRIMARY SPARES
   B= RETAIN PRIMARY AND SECONDARY SPARES

5. REWRITES THE SPARE SECTOR ON A GIVEN TRACK IF A READ RETRY IS NECESSARY. THIS WILL PREVENT A LOW AMPLITUDE SPARE SECTOR FROM INTERFERING WITH THE PLL CIRCUITRY.

6. CHECKS CRC AFTER A WRITE. THIS CHECKS FOR OSCILLATOR FAILURE ON THE DMA BOARD. IF THERE IS A FAILURE, DERROR 106 (OR 6A IN HEX) WILL BE GENERATED.

7. THE DRIVE WILL REQUEST RELEASE TO UPDATE THE MAINTENANCE TRACKS AFTER EVERY FAULT OR UNCORRECTABLE ERROR DURING RUN TIME. THIS WILL PREVENT USEFUL SERVICE INFORMATION FROM BEING LOST IN RAM IF THE DRIVE IS POWERED DOWN OR CLEARED.

8. DERROR'S 10, 11, AND 12 HAVE BEEN ELIMINATED AND THE CAUSE OF DERROR 13 HAS BEEN CHANGED TO:

   WHEN CHECK WAS MADE OF THE SECTOR HEADER READ FROM THE DISC, THE FIRST BYTE (STATUS) AND THE SIXTH BYTE (SPARE) DID NOT CONTAIN SECTOR NUMBERS POINTING TO THE SAME SECTOR.

   SUSPECT HARDWARE FOR THIS ERROR IS 1.) READ/WRITE PCA 2.) DMA PCA

ACTION: THIS IS A NON-MANDATORY CHANGE, HOWEVER ALL FSI SHOULD BE ROLLED TO THE NEW FIRMWARE. THE NEW EPROM KIT IS 07914-10003 AND THE EXCHANGE KIT IS 07914-19003.

THE KIT, 07914-19003, WILL BE SUPPLIED THROUGH CPC BLUE STRIPE EXCHANGE PROGRAM. ALL FSI IS TO BE UPDATED TO 07914-19003 AS SOON AS POSSIBLE. ALL EXCHANGE EPROMS ARE TO BE RETURNED TO CPC WITHIN 90 DAYS.

THE FOLLOWING IS A LIST OF THE INDIVIDUAL EPROMS AND THEIR "U" NUMBER ASSIGNMENTS ON THE MPU PCA. THE INDIVIDUAL EPROMS ARE NOT ORDERABLE.

07914-8X041	U241
07914-8X042	U261
07914-8X043	U271
07914-8X044	U291
07914-8X045	U2101
07914-8X046	U121

USING THE CS/80 REV COMMAND, THE NUMBERS RETURNED ARE 5.0 FOR ALL THE EPROMS.

7912-16

SERVICE NOTE

Supersedes: None

FOAM SHIPPING SPACER

PRODUCTS AFFECTED:
7911P
7912P
7914P

SERIAL PREFIXES INVOLVED:
2445 and greater 7914
2444 and greater 7911/12

PART AFFECTED:
5041-1305

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	N/A		

SYMPTOM: 791X pod drives show contact between the power module casing and the disc mechanism when subjected to severe shock during shipping. This contact may damage the RFI stripping on the power module.

CAUSE: Pods are shipped on their side which somewhat distorts the mechanism's shock mounts. Additional distortion caused by shock allows contact between the power module and disc mechanism.

SOLUTION: A foam shipping spacer (PN. 5041-1305) has been installed between the power module (PN 07912-60028) and the disc mechanism (PN 0791x-60100) on all 791x P Disc Drives with serial perfix 2444 (or greater). This modification will significantly reduce shock and vibration to the fragile disc mechanism as well as eliminate the possibility of contact between the power module and the mechanism. A label (PN 5180-0526), attached to the power supply, has also been added which reads:

CAUTION
FOAM SHIPPING BLOCK MUST BE REMOVED BEFORE DRIVE POWER ON.

ATTENTION
LE BLOQUE POLY-ETHYLENE UTILISE DURANT L'ENVOI DOIT ETRE ENLEVE AVANT LA MISE EN MARCHE DE L'APPAREIL.

VORSICHT
DER VERSANDBLOCK MUSS VOR INBETRIEBNAHME DES GERAETES ENTFERNT WERDEN.

ACTION: Remove the foam spacer during the installation of the 791X P Disc Drive. It is visible from the top of the drive when the flip top cover is removed. This should only take a second when unlocking the two shipping locks on the disc mechanism. Retain the foam spacer for reuse should the drive be shipped again.

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9320-4766 (1/83)

HEWLETT PACKARD

7912P/R-17

S E R V I C E N O T E

Supersedes:

MODEL NAME AND NUMBER:
791X Standard and Opt.
015 Disc Drives

PART NUMBERS INVOLVED:
07914-10003
07914-19003
07914-89042

SERIAL NUMBERS INVOLVED:
7911/12 From: 2429
To: 2503
7914 From: 2430
To: 2504

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	0.5hr.		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	March 31, 1986		

TITLE: 791X FIRMWARE REVISION 5.1

SYMPTOM: On standard and option 015 (220v,50Hz) drives with MR5 firmware a Derror 229 (sector miscompare) can occur during a disc-to-tape pushbutton backup.

CAUSE: If a read retry occurs during a pushbutton backup, the firmware improperly accesses the spare table in RAM to rewrite the spare sector. Therefore, instead of the spare sector being rewritten logical sector 0 is rewritten with a physical sector 0 in the header. Since physical sector 0 does not exist, a sector miscompare (D229) occurs.

SOLUTION: The solution to this problem is firmware revision 5.1. This eliminates the rewrite of the spare sector during disc-to-tape backups. The spare sector is still rewritten if an uncorrectable data error occurs during normal disc operation.

The 5.1 revision is implemented on PROM #2 (U261). Therefore, drives with MR5 can be be upgraded by replacing PROM #07914-89042 with PROM #07914-89142. This upgrade is strongly recommended for all drives upgraded to MR5 and for drives with serial prefixes 2430 to 2504 (or 2429 to 2503 for 7911/12 drives.

MR5.1 firmware kits 07914-10103 (new) and 07914-19103 (exchange) are available through CPC. These kits replace MR5 kits 07914-10003 and 07914-19003, respectively.

SH/sg 3/85-48

9320-4766 (1/83)

HEWLETT PACKARD

Note: All FSI of MR5 kits should be returned to CPC for credit. On single part replacement, the old PROM can be scrapped. For a full upgrade, the old PROMs should be returned to CPC.

Once the firmware has been upgraded, the following procedure should be followed if a Derror 229 has occurred:

1. Do a full volume RO ERT.
2. Check Fault Log for any D229s.
3. If a D229 exists, do a WTR ERT on that sector.
4. Repeat steps 1-3 until all D229s are gone.
5. Perform a tape restore to the disc since any data in D229 sectors has been lost.

WARRANTY: DMD will accept extended warranty, 02G, as indicated below.

```
**************************************************************************
*       PARTS:  07914-89142   EPROM-MEMORY                               *
*                                                                        *
*       LABOR:  1/2 hour                                                 *
*                                                                        *
*       TRAVEL:  None                                                    *
*                                                                        *
*   When filling out the CSO, enter 20022 in the service code field.     *
**************************************************************************
```

7914P/R-01

S E R V I C E N O T E

Supersedes: None

APPLIES TO:	All Units ☐		Only Units on Agreement ☒
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	X		
PARTS:	07908-69340		
TRAVEL:	X		
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:			

TAPE DESPOOLING

UNITS AFFECTED: 7908 /11/12/14 P/R
With Tape Drives

SERIAL NUMBER
PREFIXES INVOLVED: 2301 To 2310

PARTS AFFECTED: 07908-6X340
Date Code 2237 To 2311

SYMPTOM: Tape is despooled (detached from hub) during autoload. Despooling occurs only if the unit is powered on with the cartridge in place. This symptom may oocur intermittently.

CAUSE: A specification change combined with a design fault in the tape mechansim caused despooling. (Note: an update to the tape mechanism has correted the problem.)

ACTION:
1. On failure, replace tape drives which cause tape despooling with an updated unit. The update has been performed if the date code on the tape drive MPU (on rear of tape drive, rightmost of the three large IC's) is T5PXXXX.

2. If it is not possible to replace the tape drive immediately have the customer insert the tape cartridges only after power on.

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9320-4766 (1/83)

HEWLETT PACKARD

DMD will accept extended warranty (02G) as follows:

Parts - 07908-69340, tape drive.
DMD will not accept warranty for new tape drives 07908-60340.

Labor - 1 hour

Travel - Yes

****
*
* NOTE:
*
* When completing the Customer Support Order (CSO) form, the service code block must be filled in with "20007". Failure to use the service code will result in rejection of the warranty billing.
*
****

7914P/R-02

SERVICE NOTE

Supersedes: None

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	X		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☒		See text ☐
WARRANTY EXTENDED UNTIL:	15 April '84		

7914 Disc/Tape Drive

Serial Number Prefix Less Than 2326

TITLE: Mandatory Firmware Update to PEP (P/N 07914-19002)

SYMPTOM: All 7914 discs produced prior to the 2326 prefix should be updated to PEP. Drives with a serial prefix of 2326 or greater are manufactured with the new firmware and will not require updating.

CAUSE: PEP (performance enhancement) firmware introduces significant improvements in 7914 disc reliability and performance. This firmware is backwards compatible and is common to the 7911/12/14. The outstanding result of PEP firmware is a 10-15% increase in drive performance. The additional performance is achieved by changes to the firmware code hierarchy. For often received commands (read and write), the code has been simplified.

There are also many changes in PEP firmware that increase reliability. The reliability enhancements are listed below:

1. "8.dd"
   Diagnostics, initiated by DIAG1 from the External Exerciser, or from MPU switches, will now return an "8.dd" error code only when an uncorrectable error is encountered by the full volume error rate test (ERT). Previous firmware reported an "8.dd" when either an uncorrectable or correctable error was discovered. (The equivalent error logged in the fault log will be TERROR 221. The ERT log will contain the location and type of error of all errors encountered by the ERT, regardless of firmware revision.)

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The error rate design specifications and data capacity are such that a correctable error could be encountered once every full volume read of a 7914. Much confusion resulted when this was reported as a diagnostic failure. Because of the frequency of this problem, and to encourage this update, DMD will pay parts and labor for this firmware update to the 7914's.

2. Timeout
   The possibility of microprocessor hangs as a result of erroneous PHI chip interrupts is eliminated. This will decrease the causes of channel time-outs.

3. Tape Restore Errors
   The busy light will flash at the end of a push-button restore if an uncorrectable error has occurred.

4. End of File
   Error conditions are now less likely to affect the recognition of end of file on the tape.

ACTION: At next site visit, replace the existing firmware with PEP, p/n 07914-19002. The following is a list of the part numbers of the individual EPROMS in the kit versus their "U" number assignments on the microprocessor PCA. The individual EPROMS are not orderable.

07914-89031	U241
07914-89032	U261
07914-89033	U271
07914-89034	U291
07914-89035	U2101
07914-89036	U121

The kit, 07914-19002, will be supplied through CPC (Div. 15) Blue Stripe exchange program. All FSI is to be updated to PEP as soon as possible.

NOTE: On dual controllers (option 001) update only the disc MPU (A3).

DMD will accept extended warranty (02G) as follows:

Parts - 07914-19002
Labor - yes (.5HR)
Travel - no

```
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
*   NOTE:                                                 *
*   When completing the Customer Support Order (CSO)      *
*   form, the service code block must be filled in        *
*   with "20012". Failure to use the service code         *
*   will result in rejection of the warranty billing.     *
*                                                         *
* * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

7914P/R-03

S E R V I C E N O T E

Supersedes: None

AFFECTED PRODUCTS: 7911P/R
7912P/R
7914P/R

AFFECTED SERIAL PREFIX: 2330

PART NUMBER INVOLVED: 07912-60111

7911/12/14 SPEED SENSOR ASSEMBLIES
(SPEED TRANSDUCERS)

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure ☒	Information Only ☐

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:	Yes		
PARTS:	07912-60111		
TRAVEL:	Yes		

SERVICE INVENTORY	Return for update ☐	Use as is ☐
	Return for salvage ☐	See text ☒

WARRANTY EXTENDED UNTIL: May 1, 1984

SYMPTOM: Intermittent speed transducer failures resulting in self test error 9.97 (hex), which decodes as "disc not able to spin up."

CAUSE: Recent speed sensor assemblies with bad crimps at the motherboard connectors.

ACTION: Replace the speed sensor assembly P/N 07912-60111.

DO NOT replace a mechanism for this problem.

If the spin-up error continues see the "Guidelines For 7911/12/14 Mechanism Troubleshooting". (Support Update Supplement, May 13, 1983, #274, CE Handbook Update, October '83. 7911/12/14 Service Manual Update, October '83.)

DMD will accept extended warranty (02G) as follows:

Parts - 07912-60111
Labor - 0.5 hr.
Travel - Yes

* *
* NOTE: When completing the Customer Support Order (CSO) form, the service code block must be filled in with "20013". Failure to use the service code will result in rejection of the warranty billing. *
* *

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HEWLETT PACKARD

7914P/R-04

S E R V I C E N O T E

Supersedes:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X

SERVICE INVENTORY	Return for update ☐	Use as is ☐
	Return for salvage ☐	See text ☒

WARRANTY EXTENDED UNTIL: N/A

Model Numbers: 7908, 7911, 7912, 7914

Parts Involved: Boxes of five tapes;
88140L, 88140LC, 88140S, 88140SC

Individual tapes; P/N 9164-0156, 9164-0127, 9164-0211, 9164-0212

Revision Numbers involved: X0XXX-XXXX through X4XXX-XXXX

TITLE: TAPE CARTRIDGE REPLACEMENT

SYMPTOM: Tape cartridges purchased prior to October 1, 1983, or cartridges having a revision number with a second digit of "4" or lower stamped on the metal back plate (for example, X4XXX-XXXX) are subject to the following failures.

- Data loss, may result in auto sparing or verify failures.
- Shortened tape life.
- Autoload failures, cartridge fail LED may be on.
- Cartridge may unload during a read or write with a possible off tape status.

These failures are caused by a white dust that can be released from the tape. This dust collects on the cartridge guide pins, tensioning belt, and the recording surface of the tape and can cause both read and write errors. The contamination can also collect on the tape drive heads.

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SOLUTION: All tapes prior to revision "5" should be returned by the customer to HP for replacement. The method of replacement is:

. UNITED STATES -
Return tapes to:
Hewlett Packard Company
Computer Supplies Operation
1326 Kifer Road
Sunnyvale, CA 94086
Contact CSO sales development (408 720-2343) for details and to request a pre-authorized return form. Any questions should be directed to Mark Manqueros at CSO, (408) 720-2433, COMSYS A500.

. HPSA -
Tape replacement will be handled by the sales force 09 group in each European country, with the SF09 managers acting as the contact person for questions. Replacements will be supplied to customers immediately following the return of defective cartridges. Dieter Heck, BBN x 2118, COMSYS 6017, will be coordinating the program and any questions that cannot be answered locally should be addressed to him.

. ICON -
The replacement will be handled locally by the Country Support Administration Manager and the ACEM's, with the ACEM's coordinating the replacement to distributors. Please contact them for details. If questions cannot be answered by the local contacts, please direct them to Joyce Smith, ICON (Div. 18), (415) 857-3707.

. CANADA -
Canadian customers received the same packet of information and preauthorization as United States customers, and certainly that replacement procedure will be supported by CSO. But due to customs regulations, shipping tapes to CSO across an international boundary is slow and complex. For these reasons, Canada will set up their own replacement program through the Canadian Parts Distribution Center, 2050. Customers should call one of the following numbers:

Manitoba and West	1-800-387-3154
Toronto	671-8383
Ontairo	1-800-268-6982
Quebec and East	1-800-387-3417

Any questions should be directed to Rob Young, COMSYS 2050.

HEAD CLEANING: Please encourage all customers to clean the head and capstan regularly; a minimum of once a week. Also, the cleaning procedure should be the first step in tape drive troubleshooting. For head/capstan cleaning procedures, refer to the Operating and Installation Manual (07908-90902 or 07912-90902), or the Operator Instructions (07908-90901 or 07912-90901) for details.

WARRANTY: . Tape replacement through CSO.
. Only revision "5", or greater tapes, will be supported by DMD. Warranty will not apply to failures caused by use of old revision (0 - 4) tapes after July, 1984.

7914P/R-05

SERVICE NOTE

Supersedes: None

7914P/R Disc/Tape Drive

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	Effective thru 10/84		

UNITS AFFECTED: All

TITLE: 7914 Installation Procedure

SYMPTOM: Performing this installation procedure may reduce the possibility of occurrence of DERROR's (decimal) 14 and 229, and uncorrectable data errors.

CAUSE: DMD is investigating head shift which can result from thermal cycling during shipping. Because the heads can move away from data previously written (at the factory), the Read/Write PCA may not be able to sync on the offset data. DERROR 14 (header status byte error) or 229 (sector compare error), TERROR 9.92 (hex) (track compare error), or uncorrectable data errors may result.

SOLUTION: This procedure will "zero out" all the head positions upon installation at the customer's site.

1. Remove the shipping locks.
2. Reseat the PCA's in card cage.
3. Power on the drive and let it warm up for 25 minutes. Running internal random write-then-read (WTR) error rate tests while the drive is warming up is recommended.
4. Perform an "INIT MEDIA" retaining all spares.
5. Clear the ERT Log and run one full volume pass of WTR ERT.
6. Read the ERT Log and Fault Log. There should be no uncorrectable errors or DERRORS logged.
7. Power the drive on and off. Run diagnostics from the self test diagnostic switch.

To run the tests, the Hp-85 External Exerciser or host resident Exerciser (CS80DIAG, EXER, etc.) should be used.

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This procedure is intended to take less than one hour, so there will be no change to the installation charge for the 7914P, 7914R, 7914TD, or 7914ST.

Performing this procedure upon installation will reduce the chance of these symptoms occurring. In some cases, temperature changes in the customer's environment can precipitate these symptoms or can cause TERROR's 8.C5 (hex) (ECC correctable sector not correct), C6 (Write/Read test on maintenance track failed), or C7 (Read/Write test verify error). If any of these symptoms develop, consult your mass storage TSE.

7914P/R-06

SERVICE NOTE

Supersedes: NONE SUPERSEDES:

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X

SERVICE INVENTORY	Return for update ☐	Use as is ☐
	Return for salvage ☐	See text ☒

WARRANTY EXTENDED UNTIL: N/A

TITLE:NEW FIRMWARE FOR 7914 P/R DISC DRIVES (REV 5.0, P/N 07914-19003)

SYMPTOM: NEW FIRMWARE IS BEING IMPLEMENTED IN 7914 P/R DISC DRIVES BEGINNING WITH SERIAL PREFIX 2430. THIS FIRMWARE (REV. 5.0) WILL PROVIDE THE FOLLOWING ENHANCEMENTS.

1. READ FULL SECTOR WILL BE IMPLEMENTED. THIS COMMAND EXISTS ON "EXRSI2" AS RF SECTOR. EXECUTING RF SECTOR WILL RETURN THE HEADER BYTES, THE DATA BYTES, THE CRC BYTES, AND ECC BYTES OF THE SPECIFIED SECTOR.

2. IN MR5, RUN TIME INFORMATION (RUN LOG) WILL BE REPORTED DIFFERENTLY THAN ERT TEST INFORMATION. CORRECTABLE ERRORS WILL NO LONGER BE COUNTED DURING DATA TRANSFERS. IN ADDITION, RECOVERABLE ERRORS WILL BE COUNTED BUT NOT HAVE THEIR ADDRESSES LOGGED. THIS MEANS THAT THE RECOVERABLE ERROR COUNT WILL APPEAR WHERE THE CORRECTABLE ERROR COUNT USED TO APPEAR IN THE "EXRSIZ" PRINTOUT. MARGINAL RECOVERABLE ERROR AND UNRECOVERABLE ERROR HANDLING WILL BE UNCHANGED.

ERROR TYPE:	DEFINITION:	RUN LOG:	ERT LOG:
CORRECTABLE	CORRECTED BY ECC	IGNORED	COUNTED
RECOVERABLE	RECOVERED BY ONE RETRY	COUNTED	ADDRESS RECORDED
MARGINAL	RECOVERED BY MORE THAN ONE RETRY	ADDRESS RECORDED	ADDRESS RECORDED
UNRECOVERABLE	NOT RECOVERED IN 800 MSEC	ADDRESS RECORDED	ADDRESS RECORDED

3. INCREASES THE DEFAULT RETRY TIME TO 800 MSEC FROM 100 MSEC. THIS ALLOWS FOR A MORE AGGRESSIVE READ OFFSET DURING RETRIES.

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4. ADDS AN INITIALIZE MEDIA OPTION WHICH ONLY WRITES THE MAINTENANCE TRACKS AND LEAVES THE USER DATA ALONE. IN "EXRSI2", INIT MEDIA HAS BEEN MODIFIED TO GIVE THE FOLLOWING CHOICES:

   I= INITIALIZE MAINTENANCE TRACKS ONLY. (THIS IN NO LONGER PHYSICAL FORMAT)
   P= RETAIN ONLY PRIMARY SPARES
   B= RETAIN PRIMARY AND SECONDARY SPARES

5. REWRITES THE SPARE SECTOR ON A GIVEN TRACK IF A READ RETRY IS NECESSARY. THIS WILL PREVENT A LOW AMPLITUDE SPARE SECTOR FROM INTERFERING WITH THE PLL CIRCUITRY.

6. CHECKS CRC AFTER A WRITE. THIS CHECKS FOR OSCILLATOR FAILURE ON THE DMA BOARD. IF THERE IS A FAILURE, DERROR 106 (OR 6A IN HEX) WILL BE GENERATED.

7. THE DRIVE WILL REQUEST RELEASE TO UPDATE THE MAINTENANCE TRACKS AFTER EVERY FAULT OR UNCORRECTABLE ERROR DURING RUN TIME. THIS WILL PREVENT USEFUL SERVICE INFORMATION FROM BEING LOST IN RAM IF THE DRIVE IS POWERED DOWN OR CLEARED.

8. DERROR'S 10, 11, AND 12 HAVE BEEN ELIMINATED AND THE CAUSE OF DERROR 13 HAS BEEN CHANGED TO:

   WHEN CHECK WAS MADE OF THE SECTOR HEADER READ FROM THE DISC, THE FIRST BYTE (STATUS) AND THE SIXTH BYTE (SPARE) DID NOT CONTAIN SECTOR NUMBERS POINTING TO THE SAME SECTOR.

   SUSPECT HARDWARE FOR THIS ERROR IS 1.) READ/WRITE PCA 2.) DMA PCA

ACTION: THIS IS A NON-MANDATORY CHANGE, HOWEVER ALL FSI SHOULD BE ROLLED TO THE NEW FIRMWARE. THE NEW EPROM KIT IS 07914-10003 AND THE EXCHANGE KIT IS 07914-19003.

THE KIT, 07914-19003, WILL BE SUPPLIED THROUGH CPC BLUE STRIPE EXCHANGE PROGRAM. ALL FSI IS TO BE UPDATED TO 07914-19003 AS SOON AS POSSIBLE. ALL EXCHANGE EPROMS ARE TO BE RETURNED TO CPC WITHIN 90 DAYS.

THE FOLLOWING IS A LIST OF THE INDIVIDUAL EPROMS AND THEIR "U" NUMBER ASSIGNMENTS ON THE MPU PCA. THE INDIVIDUAL EPROMS ARE NOT ORDERABLE.

07914-8X041	U241
07914-8X042	U261
07914-8X043	U271
07914-8X044	U291
07914-8X045	U2101
07914-8X046	U121

USING THE CS/80 REV COMMAND, THE NUMBERS RETURNED ARE 5.0 FOR ALL THE EPROMS.

7914P/R-7

SERVICE NOTE

Supersedes: None

7914P/R NEW READ/WRITE PCA

SERIAL PREFIXES INVOLVED:
2430 and greater

Part numbers involved:

07914-60104 new
07914-69104 exchange

replaces:
07914-60004 new
07914-69004 exchange

APPLIES TO:	All Units ☒	Only Units on Agreement ☐
PERFORM:	Immediately ☐	At PM/Normal Call ☐
	On Failure ☐	Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X

SERVICE INVENTORY	Return for update ☐	Use as is ☐
	Return for salvage ☐	See text ☒

WARRANTY EXTENDED UNTIL: N/A

7914P/R Disc Drives with serial prefix 2430 (or greater) will have a new Read/Write PCA (part no. 07914-60104) replacing the older Read/ Write PCA (part no. 07914-60004). The new Read/Write PCA can easily be identified by its red extractor tabs.

A major design change was made to the read/write electronics to improve timing margins. This new Read/Write PCA will give the 7914 Disc drive improved data error rate performance.

Add the new R/W PCA (part # 07914-69104) to FSI to support 7914P/R Disc Drives.

The 07914-69104 board cannot be used in the 7911 and 7912 Disc Drives because of cross talk incompatibility with the servo system. The 07914-69004 will continue to be used in the 7911 and 7912 Disc Drives.

When troubleshooting 7914R/P Read/Write problems, PLEASE TRY:

1)a new Read/Write PCA (part no. 07914-69104)
2)reformating the disc using the new firmware (part no. 07914-19003) with INIT MEDIA option I.
3)reformating the disc again with INIT MEDIA option B (caution: this will destroy customer data).

HW/sg BEFORE replacing the disc mechanism. 9/84-48

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HEWLETT PACKARD

7914P/R-8

SERVICE NOTE

Supersedes: None

APPLIES TO:	All Units☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☐
	On Failure ☐		Information Only ☒

WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X

SERVICE INVENTORY	Return for update ☐	Use as is ☐
	Return for salvage ☐	See text ☒

WARRANTY EXTENDED UNTIL: N/A

NEW SERVO PCA

UNITS AFFECTED:
7914 P/R

SERIAL NUMBER
PREFIXES INVOLVED: 2444

PARTS AFFECTED:
07914-60001 NEW
07914-69001 EXCHANGE

DATE CODE CHANGE TO: D-2444

SYMPTOM: A MODIFICATION TO THE SERVO PCA WILL REQUIRE THE DATE CODE TO CHANGE TO D-2444.

CAUSE: THE SERVO DIBIT WEIGHTING CIRCUIT WAS FOUND TO OFFSET THE SERVO HEAD 46 MICRO-INCHES FURTHER THAN THE NOMINAL QUARTER TRACK OFFSET OF 516 MICRO-INCHES. A CHANGE TO THE SERVO PCA WAS MADE TO MORE CORRECTLY SPACE THE DATA TRACKS.

SOLUTION: NO ACTION IS NECESSARY. THIS IS AN INFORMATION ONLY SERVICE NOTE.

NOTE: WHEN REPLACING A SERVO PCA (REV D-2444) IN A DRIVE INITIALIZED WITH A PRE REV D-2444 SERVO PCA, BE SURE TO RUN A FULL VOLUME READ ONLY ERROR RATE TEST. IF A PROBLEM IS INDICATED, CARE SHOULD BE EXERCISED IN TROUBLESHOOTING. DUE TO THE SLIGHT CHANGE IN DATA TRACK SPACING, PREVIOUSLY MARGINAL CONDITIONS COULD NOW CAUSE UNRECOVERABLE ERRORS. INVESTIGATE THE ROOT CAUSES, I.E. HEAD-SHIFT, READ/WRITE PCA, ETC AND THEN RE-INITIALIZE MEDIA.

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HEWLETT PACKARD

7914-09

SERVICE NOTE

Supersedes: None

FOAM SHIPPING SPACER

PRODUCTS AFFECTED:
7911P
7912P
7914P

SERIAL PREFIXES INVOLVED:
2445 and greater 7914
2444 and greater 7911/12

PART AFFECTED:
5041-1305

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	EXTENDED	NORMAL	NONE
LABOR:			X
PARTS:			X
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	N/A		

SYMPTOM: 791X pod drives show contact between the power module casing and the disc mechanism when subjected to severe shock during shipping. This contact may damage the RFI stripping on the power module.

CAUSE: Pods are shipped on their side which somewhat distorts the mechanism's shock mounts. Additional distortion caused by shock allows contact between the power module and disc mechanism.

SOLUTION: A foam shipping spacer (PN. 5041-1305) has been installed between the power module (PN 07912-60028) and the disc mechanism (PN 0791x-60100) on all 791x P Disc Drives with serial perfix 2444 (or greater). This modification will significantly reduce shock and vibration to the fragile disc mechanism as well as eliminate the possibility of contact between the power module and the mechanism. A label (PN 5180-0526), attached to the power supply, has also been added which reads:

CAUTION

FOAM SHIPPING BLOCK MUST BE REMOVED BEFORE DRIVE POWER ON.

ATTENTION

LE BLOQUE POLYETHYLENE UTILISE DURANT L'ENVOI DOIT ETRE ENLEVE AVANT LA MISE EN MARCHE DE L'APPAREIL.

VORSICHT

DER VERSANDBLOCK MUSS VOR INBETRIEBNAHME DES GERAETES ENTFERNT WERDEN.

ACTION: Remove the foam spacer during the installation of the 791X P Disc Drive. It is visible from the top of the drive when the flip top cover is removed. This should only take a second when unlocking the two shipping locks on the disc mechanism. Retain the foam spacer for reuse should the drive be shipped again.

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HEWLETT PACKARD

7914P/R-10

S E R V I C E N O T E

Supersedes:

MODEL NAME AND NUMBER:
791X Standard and Opt.
015 Disc Drives

PART NUMBERS INVOLVED:
07914-10003
07914-19003
07914-89042

SERIAL NUMBERS INVOLVED:
7911/12 From: 2429
To: 2503
7914 From: 2430
To: 2504

APPLIES TO:	All Units ☒		Only Units on Agreement ☐
PERFORM:	Immediately ☐		At PM/Normal Call ☒
	On Failure ☐		Information Only ☐
WARRANTY:	**EXTENDED**	**NORMAL**	**NONE**
LABOR:	0.5hr.		
PARTS:	X		
TRAVEL:			X
SERVICE INVENTORY	Return for update ☐		Use as is ☐
	Return for salvage ☐		See text ☒
WARRANTY EXTENDED UNTIL:	March 31, 1986		

TITLE: 791X FIRMWARE REVISION 5.1

SYMPTOM: On standard and option 015 (220v,50Hz) drives with MR5 firmware, a Derror 229 (sector miscompare) can occur during a disc-to-tape pushbutton backup.

CAUSE: If a read retry occurs during a pushbutton backup, the firmware improperly accesses the spare table in RAM to rewrite the spare sector. Therefore, instead of the spare sector being rewritten, logical sector 0 is rewritten with a physical sector 0 in the header. Since physical sector 0 does not exist, a sector miscompare (D229) occurs.

SOLUTION: The solution to this problem is firmware revision 5.1. This eliminates the rewrite of the spare sector during disc-to-tape backups. The spare sector is still rewritten if an uncorrectable data error occurs during normal disc operation.

The 5.1 revision is implemented on PROM #2 (U261). Therefore, drives with MR5 can be be upgraded by replacing PROM #07914-89042 with PROM #07914-89142. This upgrade is strongly recommended for all drives upgraded to MR5 and for drives with serial prefixes 2430 to 2504 (or 2429 to 2503 for 7911/12 drives.

MR5.1 firmware kits 07914-10103 (new) and 07914-19103 (exchange) are available through CPC. These kits replace MR5 kits 07914-10003 and 07914-19003, respectively.

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HEWLETT PACKARD

Note: All FSI of MR5 kits should be returned to CPC for credit. On single part replacement, the old PROM can be scrapped. For a full upgrade, the old PROMs should be returned to CPC.

Once the firmware has been upgraded, the following procedure should be followed if a Derror 229 has occurred:

1. Do a full volume RO ERT.
2. Check Fault Log for any D229s.
3. If a D229 exists, do a WTR ERT on that sector.
4. Repeat steps 1-3 until all D229s are gone.
5. Perform a tape restore to the disc since any data in D229 sectors has been lost.

WARRANTY: DMD will accept extended warranty, 02G, as indicated below.

```
**************************************************************************
*       PARTS:  07914-89142   EPROM-MEMORY                               *
*                                                                        *
*       LABOR:  1/2 hour                                                 *
*                                                                        *
*       TRAVEL:  None                                                    *
*                                                                        *
*   When filling out the CSO, enter 20022 in the service code field.     *
**************************************************************************
```